The Role of Personal Experience in Forming Spatial Presence in a Video Gaming Context

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Abstract

Based on the Two Level Process Model of Spatial Presence proposed by Wirth et al. (2007), the current study examined how four types of personal experience (direct real, direct virtual, indirect real, indirect virtual) influence the formation of situational spatial models (SSMs) and spatial presence during video game play. A quasi-experiment was conducted in which participants ($N = 100$) played a basketball video game and completed a variety of measures, including of personal experience types, attitudes, gaming skill, SSMs, spatial presence, and congruence. Results partially supported the assumption that personal experience would relate to SSMs. Furthermore, gaming skill and congruence were also found to be positively related to SSMs and spatial presence, respectively. Implications are discussed.
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In recent decades, video games have become pervasive entertainment for people all over the globe. According to The Entertainment Software Association (2011b), the video game industry generated $24 billion in revenue in 2010. Furthermore, computer and video games are now played in 67 percent of American Households (Entertainment Software Association, 2011a). Video games are clearly enormously popular and playing a major role in people’s media lives; however, knowledge about the mechanisms behind human interaction with games is still insufficient as well as necessary.

One reason for the emergent popularity of gaming may be presence, defined as “the perceptual illusion of nonmediation” (Lombard & Ditton, 1997). Presence is a relatively new subject of academic study, but because of its pervasiveness in media experiences, it is an important concept in studying how people interact with media, particularly video games (Tamborini & Skalski, 2006). The development of new gaming innovations over time, such as improved graphics and control devices mapping real body action like the Nintendo Wii and Microsoft Kinect, has provided the players with higher senses of presence. Hence, research incorporating games with presence is necessary and valuable to our comprehension of interaction between humans and the game medium. Studies have already been conducted of various factors that may influence presence in gaming, including natural controls (Skalski, Tamborini, Shelton, Buncher, & Lindmark, 2011). However, previous personal experience, a potentially important variable, has been largely ignored by many scholars. The current study will examine the role of personal experience in the process of interaction between people and video games, and its impact on media users’ sensation of presence based on a framework of the Two Level Process Model of Spatial Presence proposed by Wirth et al. (2007).
The Concept of Presence

According to Reeves and Nass (1996), the human brain evolved in a world in which only humans exhibited rich social behaviors and a world in which all perceived objects were real physical objects. Thus, acceptance of what only seems to be real is automatic. For this reason, people cannot always overcome the powerful assumption that mediated presentations are actually not people and objects. Reeves and Nass’ media equation studies primarily focused on human-computer interaction and they did not use the term “presence” in their research; however, according to Lee (2004b), media equation studies can be linked with presence and considered as early presence studies.

Building on early presence conceptualization work by Heeter (1992), Biocca (1997), and Lombard and Ditton (1997), Lee (2004a) defined physical presence as a psychological state that virtual physical objects are experienced as physical objects in either sensory or nonsensory ways, social presence as a psychological state in which virtual social actors are experienced as real social actor in either sensory or nonsensory ways, and finally self presence as a psychological state involving a virtual self or selves experienced as actual self or selves in either sensory or nonsensory ways. Although the concept of presence has been explicated differently in different studies, it is clear that this research consistently considers presence from users’ physical or spatial, social, and self feeling aspects (Bracken & Skalski, 2010).

However, there is still much to be discovered about why presence occurs. Based on previous research, Lee’s study (2004b) indicated that the fundamental mechanisms behind the sense of presence could be explained evolutionarily by the modularity of human minds. Specifically, people’s automatic and natural responses to mediated stimuli are primarily because
humans automatically apply “folk-physics modules” and “folk-psychology modules” when they interact with a mediated environments and process media stimuli. For example, people judge virtual objects based on screen size (Lombard, Reich, Grabe, Bracken, & Ditton, 2000), and they automatically apply a size-judgment module to a virtual environment.

In addition to mechanisms behind presence, factors that can contribute to achieve a sense of presence have been a major focus of presence research. In general, three types of factors that can influence presence include: media form (e.g., image and audio quality), media content (e.g., social realism), and media users’ individual characteristics and differences (Lombard & Ditton, 1997).

Spatial Presence in Video Games and the Two Level Process Model of Spatial Presence

Spatial presence refers to a sense or psychological state of physically experiencing virtual objects and environments, or being located in virtual environment (Ijsselsteijn, de Ridder, Freeman, & Avons, 2000; Lee, 2004a). According to Biocca (1997), people will automatically generate a mental model of an external physical space experienced by their sensory organs. This sense of locating in the space formed by real physical space is stable and easily activated. Hence, when people are engaged in a virtual environment that simulates an actual physical space, their mental models formed in the real world will be activated and automatically generate a similar sense of locating in the current virtual space, which is a sense of spatial presence.

Wirth et al. (2007) suggested personal differences play an essential role in forming and maintaining players’ sensation of spatial presence. Based on their process model of spatial presence:
Spatial Presence is a binary experience, during which perceived self-location and, in most cases, perceived action possibilities are connected to a mediated spatial environment, and mental capacities are bound by the mediated environment instead of reality. (p. 497)

According to this model, the formation of people’s spatial presence can be divided into two steps. The first step is a process to construct a spatial situation model (SSM), and the second step is a process of promoting from the SSM to a sensation of spatial presence. Specifically, SSM refers to a mental model of the spatial environment that the individual constructs based on spatial cues he/she processed and relevant personal spatial memories and cognitions (McNamara, 1986). The formation of the SSM is related to various user and media factors, such as users’ ability with spatial visual imagery, attention allocation (involuntary and controlled attention), and spatial cues provided by media.

After the SSM constructed in the first step, in the second step, users will progress from the SSM to a sensation of spatial presence. In this process, several factors will have impact on the development of the process. To give users a feeling of being located in a virtual environment, the SSM developed in the first step or the current mediated environment has to be considered as Primary Ego Reference Frame (PERF) so that users’ perceived self-location, perceived possible actions and mental capacities are all bound to the mediated space, which gives users the sense of spatial presence. Competing with each other, a stronger SSM constructed in the first step is obviously more likely to be considered as PERF because it is more plausible and only needs less information to confirm it. However, it is not to say that users will not achieve spatial presence without a strong SSM. Various media factors, such as realism of media content, interactivity, and persistent spatial cues; and user factors, such as involvement, suspension of disbelief, and trait
absorption will also influence users’ hypotheses confirmation proceeding to spatial presence (Wirth et al., 2007).

In sum, as the theoretical foundation of the current study, the Two Level Process Model of Spatial Presence suggested to explore factors that can influence spatial presence through people’s mental models. This study considers personal experience as a new possible factor that may be influential in the process of forming spatial presence.

**Personal Experience in Previous Literature**

Although personal experience is often treated as a primitive concept, attempts have been made at explicating it. Some scholars have divided it into direct experience and indirect experience (Fazio, Zanna, & Cooper, 1978; Millar & Millar, 1998). Generally, the notion that direct experience is better than indirect experience has been supported by empirical evidence (Fazio & Zanna, 1981). More extensively, Millar and Millar (1996) found that direct experience with an attitude object will produce more affective reactions than indirect experience; in contrast, indirect experience with an attitude object will produce more cognitive reactions than direct experience. Furthermore, the authors suggested that the attitude produced by direct experience is more likely to relate with people’s consummatory behaviors (i.e., the goal of the behavior is activity involved in performing it, with more focus on intrinsic enjoyment of the activity, such as watching a movie for fun). Based on such research results, another pair of relationships were also supported, which is that attitudes formed through direct experience are more accessible when people are in consummatory situations; in contrast, attitudes formed through indirect experience are more accessible when people are in instrumental situations.
In other scholars’ research, personal experience was defined differently. For example, Lee (2004a) categorized human experience into three types: real experience, virtual experience, and hallucination, according to the ways of experiencing and objects that are being experienced. He suggested that a human’s ways of experiencing can be divided into sensory experiencing and nonsensory experiencing. The objects that are being experienced by a human can be divided into actual objects (objects existing in real world), imaginary objects, and virtual objects (which can be further divided into para-authentic, which refers to virtual objects that have counterpart in real world, and artificial, meaning virtual objects that only exist in virtual world). Based on this typology, he defined people’s real experience as sensory experience of actual objects. Hallucination refers to people’s nonsensory experience of imaginary objects, and virtual experience can be defined as people’s sensory or nonsensory experience of para-authentic or artificial objects.

Explication of Personal Experience

Based on above discussion of human experience, the current explication is constructed on two binary properties of a process of gaining experience, which are directness and context. Each property has two values; specifically, the values of directness (direct and indirect), and the values of context (real and virtual). A combination of values of each property will form a type of prior experience (e.g., direct-real); hence, four types of prior experience can be formed. As for the property of directness, the term refers to ways of people interacting with an object, event, or process. Direct means that people personally interact with an object without any intermediaries; in contrast, indirect means that people non-personally interact with an object without actually touching on the object. In regard to the property of context, the term refers to contexts that provide an object, event or process for people to interact with. It does not overlap with
directness, and the term can be differentiated by real and virtual. Real means that objects, events or processes people interact with occur in a real world, and virtual means that objects, events or processes people interact with occur in a virtual environment. Although some objects can be found in either a real world or virtual environment (e.g., basketball games), in the current study, the context is determined by the occurrence of objects in specific situations.

Consequently, four types of experience can be formed, as shown in Table 1 with examples. They are: 1) Direct real experience, which refers to people’s knowledge or skills that are gained through actively and personally being involved in an event, process or object in the real world; 2) indirect real experience, which refers to people passively gaining knowledge or skills about an object, event, or process occurring in the real world; 3) direct virtual experience, which refers to experience gained through personally interacting with an object, event, or process provided by a virtual environment, and 4) indirect virtual experience, which refers to people passively gaining knowledge or skills about an object, event, or process provided by a virtual environment.

**Personal Experience as a User Factor in the Two Level Process Model of Spatial Presence**

At the first level of the Two Level Process Model of Spatial Presence (Wirth et al., 2007), people will form different spatial situation models (SSM) based on different media and user factors they encounter. A stronger spatial situation model will promote a stronger sensation of spatial presence. Similar to studies on mental models, situation models are also dynamic and impacted by information processed by media consumers’ prior experience (van Dijk & Kintsch, 1983; Blanc & Tapiero, 2001). Specifically, two perspectives on the process of updating situation models were suggested by scholars. One is the online hypothesis, which considered that
newly processed information is integrated into the situation model being constructed (Glenberg & Langston, 1992; Zwann & Radvansky, 1998). The other perspective suggested that the updating process is delayed rather than online. People do not update their situation model during the processing of new information, but conduct the updating after they go through all the information (de Vega, 1995). Despite these conflicting ideas, the role of people’s prior experience in influencing updating processes of situation models is supported by many studies (e.g., van Dijk & Kintsch, 1983; Blanc & Tapiero).

Although most of this research used text descriptions, Dennis and Zimmer (1992) suggested that the mental models can be constructed from a verbal description as well as visual experience. Both kinds of information can generate very similar mental models for a person. Hence, the current study will extend studies discussed above to a video game context. Specifically, similar with spatial visual imagery ability, in a video game context, people’s personal experience may support the construction of a SSM directly. A person who has more personal experience with a topic/action may have a stronger capacity of working memory to keep more related information that is more accessible and comprehensible. This will positively impact the process of constructing and updating the SSM and provide the person with a more accurate and stronger SSM of the topic/action related to the game. For example, a person who often plays football in the real world or plays a football game will have a more accessible specific knowledge of football than those people who do not often play. When the person is playing a game like Madden 2011, this knowledge will be more helpful for the individual in building or updating the mental representation of the spatial arrangements portrayed by the game.

Once they have an SSM formed at the first level, people have to promote themselves from the SSM to an experiential state at the second level. According to Wirth et al., people have
to determine their positions within a spatial environment through constantly monitoring their spatial surroundings and check for inconsistencies between the outer representation and their internal sensory feedbacks related to their location. Through labeling a mediated environment as PERF, people will get the sensation of spatial presence. The perceptual hypotheses theory suggests that for a strong SSM, people only need to seek a small amount of information to confirm it as PERF. Moreover, as a user factor, personal experience will also contribute to the formation of spatial presence at this level. When a person who has personal experience with a game that he/she is interacting with or the game related topic, he/she may try to apply his/her mental model of the game or game related topic to the game environment.

Such application of a mental model may generate two results. First, if the person’s mental model can be applied to the game situation successfully (for example, if the player wins the game or gets rewarded in the game through the application), he/she may find the game more realistic or interactive, and have a stronger feeling of involvement, which will also lead the user to a higher level of spatial presence. Another possibility is that the application of his/her mental model to the game environment is not successful (for example, a user plays a basketball game according to his/her mental model of a successful strategy in real world basketball, and finds such an application cannot lead him/her to win in the game). In this case, the person may feel the game is less realistic and interactive, which will impair the formation of spatial presence.

Incorporating the above discussion with the definition of personal experience, more can be predicted. Miller and Miller (1996) suggested that in a consummatory situation, people’s attitudes formed through direct experience are more accessible, and alternatively, in an instrumental situation, attitudes formed through indirect experience are more accessible. The present study treats interaction with a video game as a consummatory behavior. Consequently,
people’s direct experience may be more influential than indirect experience in influencing their game experience. Furthermore, according to a study conducted by Arthur, Hancock, and Chrysler (1997), mental representations constructed from the experience of virtual objects are not significantly different from that of the actual objects. Hence, in a gaming situation, a research question about the effect of virtual experience and real experience in constructing a SSM can be proposed as:

RQ1: Is virtual prior experience or real experience more influential in building SSMs in a game context?

One more research question concerning the unique contribution of each individual type of prior experience to the construction of SSMs can be proposed. To answering such research question is important in understanding the role of prior experience in the process of media interaction from a more specific perspective:

RQ2: Which is the most influential in building SSMs in a game context among four types of prior experience: Direct virtual, direct real, indirect virtual, and indirect real?

Another property of prior experience – directness has not been addressed in either research question. Previous literature has indicated that direct experience is more predictive than indirect experience of people’s attitudes in a consummatory situation. Given that playing video games is more about enjoyment and could be considered as a consummatory behavior, one hypothesis about effects of directness of prior experience on building SSMs in a game situation could be proposed:

H1: In game situation, direct experience has a stronger impact on constructing SSMs than indirect experience.
In a text comprehension situation, researchers have shown the significant impact of prior experience and knowledge on building mental representations; specifically, people who have more prior experience and knowledge are more likely to build a stronger mental model of the texts they are reading. The current study generalized the finding to a game context and expected to find a similar result in such more interactive condition:

H2: People who have more game topic-related prior experience are more likely to build a strong SSM than those people who have less such prior experience.

Wirth et al. (2007) mentioned the importance of consistent spatial cues in building strong SSMs; in more detail, more consistent cues are able to evoke richer and stronger SSMs; in contrast, inconsistent cues can attract user attention, but they are not able to contribute to building strong SSMs (Zwaan & Radvansky, 1998). The literature inspired the current study to consider the role of congruence between prior experience and current game experience in the process of achieving spatial presence; therefore, the study proposed the third hypothesis as:

H3: The higher the level of congruence between people’s prior experience and current game experience, the higher level of spatial presence the people will report; alternatively, the higher the level of the incongruence between people’s prior experience and current video game experience, the lower level of spatial presence the people will report.

In addition to experience, other variables may affect the construction of SSMs, including attitudes (toward the mediated activity and the medium), skill (at playing video games), and demographics. The role of these variables is addressed in the following research question:

RQ3: How do attitudes, gaming skill, and demographics impact the construction of SSMs, respectively.
Methods

Overview and Stimulus

For this study, a quasi-experiment was designed and conducted. A quasi-experiment is a controlled experiment without random assignment (Kerlinger & Lee, 2000). In this study, people had gained certain prior experience from their daily life, and it is hard to manipulate such prior experience in a short time study; therefore, prior experience types were measured before participants interacted with the experimental stimulus.

The study was conducted in a media lab equipped with a high-resolution large screen flat TV and a XBOX 360 game console, located in a medium sized Midwestern University. A basketball game was used, since basketball is a very popular sport in the United States, and people have different experience with the sport to help the study get fairly evenly distributed condition groups. According to the user and critic’s ratings retrieved from Gamespot.com, NBA 2K10 was the best pro basketball franchise at the time, so NBA 2K10 (ESRB Rating: Everyone) was used in the experiment.

Sample Characteristics

A total of 100 college students from a medium-sized Midwestern university were selected for the experiment. Participation in the study was voluntary, and participants received extra credit or fulfilled course requirements for taking part. According to the demographic data collected, 46% of participants were male, and ages were in a range of 18 to 48, with a mean of 24 years old. In terms of race, 65% of subjects were White, 26% were African American (n = 26), and the remaining 9% were Asian, Hispanic, or Other. More than a third (38%) of subjects reported having lot of experience of playing basketball in real world, and 19% of subjects
reported that they often play basketball video games. A majority of participants (63%) also indicated that they often watch basketball games on TV, the Internet, or other media channels, and 36% of participants said they would like to watch others playing basketball rather than participate in real world basketball games. Most subjects (67%) considered themselves as knowledgeable about basketball and had positive attitudes toward playing basketball (55%) as well as toward playing video games (55%). Regarding gaming skill, only 23% of subjects indicated that they were skillful game players and able to handle a new game in a short time; in contrast, 47% of participants did not consider themselves as skillful players.

**Procedure**

After participants arrived at the lab, they were asked to complete a consent form and pre-test questionnaire. Then, they started to play the game on the system by using the default game controller and game settings, for 15 minutes. After the subject finished the interaction, he or she was asked to finish another game playing questionnaire. Participants were then debriefed and thanked for their participation.

**Measurement**

The entire measurement was divided into two questionnaires, a “Pre-test Questionnaire” and “Game Playing Experience Questionnaire.” The pre-test questionnaire measured personal prior experience, attitudes toward the real world activity (basketball) and video games, gaming skill, and subjects’ demographics information. On the second questionnaire, subjects were asked to answer questions regarding their gaming experience; specifically, these measurements were of SSM, sense of spatial presence, congruence, and attention.
**Personal prior experience.** This section included five questions measuring a subject’s types of prior experience with basketball and level of knowledge about the sport. Specifically, “I have a lot of experience playing basketball in the real world” was about measuring direct real experience, “I often play basketball video games” measured direct virtual experience, “I often watch basketball games on TV, the Internet, or other media channels” measured indirect virtual experience, “When I go to a basketball court, I usually watch people playing basketball rather than play it” was used to measure people’s indirect real experience, and “In general, I am knowledgeable about basketball” measured people’s knowledge of basketball. Subjects were asked to indicate what extent they agreed with these statements on a 1 to 7 Likert scale (with 1 meaning strongly agree, and 7 meaning strongly disagree). These measures were treated as single item indicators.

**Attitudes toward basketball and video games.** Two items composed this section. One item was designed to measure media users’ attitudes toward the mediated activity, playing basketball (e.g., “In general, I like playing basketball.”); another item was used to measure participants’ attitudes toward the medium, video games (e.g., “In general, I like playing video games.”). These two statements were also measured using the same 1 to 7 Likert scale.

**Gaming skill.** In this section, 9 items from Bracken and Skalski (2005) were used to measure a subject’s game playing skill, including “I have no problem handling the multiple buttons on currently popular game controllers” and “I can easily figure out how to play new games.” These 9 items were again measured by using a 1 to 7 Likert scale. Cronbach’s alpha of this 9 items skills scale was .96.
**Demographics.** Subjects were asked to indicate their gender, age, and race on the final section of the pre-test.

**SSM.** Six items retrieved from MEC Scale (Vorderer et al., 2004) were used to measure subjects’ spatial situation models, including “I was able to imagine the arrangement of the spaces presented in the video game very well” and “I was able to make a good estimate of the size of the presented space.” These were measured on a 1 through 5 (from strongly disagree to strongly agree) Likert scale. Cronbach’s alpha of this additive scale was .92.

**Spatial presence.** Based on the MEC scale, 8 items composed this section and were measured on a similar 1 to 5 Likert scale, including items such as “I felt I was like actually there in the environment of the video game” and “It seemed as though I actually took part in action of the video game.” Chronbach’s alpha for these items was .90.

**Congruence.** Three items were included in this section to measure subjects' feeling of congruence between the current gaming experience and their prior experience, including “The game is consistent with my understanding of basketball” and “I felt that I could successfully apply my previous knowledge about the basketball or other basketball video games to this video game.” The scale was developed by the researcher, and Cronbach’s alpha of the three item index was .74.

**Results**

**Research Question 1**

The first research question asked which one is more influential in building SSMs, virtual prior experience or real prior experience. Results indicated that both types of experience made a contribution to the construction of SSMs. Specifically, according to Pearson product-moment
correlations between each type of experience and the SSM, both people’s virtual \((r = .24, p = .007)\) and real \((r = .23, p = .010)\) experience were positively related to the construction of SSMs. A significant regression model was also found, with an \(R^2\) of \(.086 (F (2, 97) = 4.55, p = .013)\); 8.6% of variance of the SSM can be explained by people’s prior virtual and real experience, and these two types of experience significantly contribute to the construction of SSMs.

Regarding the contribution of each type of experience, neither one was found to have a significant unique contribution to the SSM. However, based on Beta coefficients of these two factors, people’s virtual experience had an almost significant unique contribution to the construction of SSMs \((\beta = .19, p = .07)\), which was larger than the unique contribution of real experience to the SSM \((\beta = .17, p = .10)\). Regarding the first research question, although virtual and real prior experience did not have a unique impact on the SSM, the results suggest that they significantly contribute to the SSM combined, and that they make a fairly equal contribution individually.

**Research Question 2**

Since an SSM plays an important role in the process of generating a sense of spatial presence, the second research question focused on the impacts of the four types of experience (direct virtual, direct real, indirect virtual, and indirect real) in building the SSM.

By using a multiple regression model, the study found that these 4 types of experience together significantly contribute to the construction of SSMs \((R^2 = .15; F (4, 95) = 4.20, p = .004)\). Specifically, 15% of variance of SSMs can be explained by these 4 types of experience, and people who have more of these types of prior experience are more likely to have a stronger SSM when playing the game. Pearson product-moment correlations results also indicated that
among 4 types of experience, two of them significantly correlated with the SSM. People’s direct real \((r = .37, p = .00)\) and direct virtual \((r = .26, p = .00)\) basketball experience were found to have positive correlations with the construction of SSMs; in other words, the more the people have direct real prior experience (e.g., playing basketball in the real world) and direct virtual prior experience (e.g., playing basketball video games), the stronger the SSM they had when playing video games. Besides those two significant correlations, people’s prior indirect virtual (e.g., watching basketball games on media channels) experience was found to have a nearly significant correlation with the SSM \((r = .16, p = .06)\). Interestingly, the last type of experience, indirect real experience, was negatively correlated with the SSM \((r = -.14, p = .08)\), though this finding was not significant.

To answer the second research question, Beta coefficients of each type of experience were reviewed. According to the results, only one out of four types of experience had significant contribution to the SSM. With a Beta coefficient of .33 \((p = .01)\), people’s direct real experience explained the most amount of variance in an SSM. Direct virtual experience was the second most influential factor to the SSM \((\beta = .14, p = .20)\), followed by indirect virtual experience \((\beta = -.04, p = .73)\) and indirect real experience \((\beta = .00, p = .98)\), though all were non-significant.

**Hypothesis 1**

The first hypothesis posited that direct experience has a stronger impact on constructing SSMs than indirect experience during video game play. To test the hypothesis, a similar multiple regression model was conducted. This time, only direct experience was found to have a significant positive correlation \((r = .38, p < .01)\) with the construction of SSMs; on the other hand, people’s indirect experience only shared a very small amount of variance with the SSM.
However, the regression model was found to be significant. Specifically, with an \( R^2 \) of .14 (\( F(2, 97) = 8.14, p < .01 \)), direct experience and indirect experience together explained 14.4% of variance of the SSM.

Moreover, the results indicated that people’s direct experience had a significant unique contribution (\( \beta = .38, p < .01 \)) to the construction of SSMs, while indirect experience does not (\( \beta = -.04, p = .65 \)). Therefore, direct experience had a stronger impact on constructing SSMs than indirect experience, in support of hypothesis 1.

**Hypothesis 2 and Research Question 3**

The second hypothesis proposed a positive relationship between people’s game topic-related prior experience and the SSM. Independent variables entered into a regression model included prior experience and knowledge (Block 1), attitudes toward basketball and games (Block 2), gaming skill (Block 3), and gender (Block 4).

Reviewing Pearson product-moment coefficients among all entered variables, most of them significantly correlated with the SSM, including knowledge (\( r = .28, p < .01 \)), gaming skill (\( r = .46, p < .01 \)), gender (\( r = .17, p = .05 \)), and attitudes toward basketball (\( r = .39, p < .01 \)) and video games (\( r = .33, p < .01 \)). On the other hand, as Table 2 shows, only gaming skill was found to have significant unique contribution to the construction of SSMs (\( \beta = .50, p < .01 \)).

However, this does not mean that hypothesis 2 was not supported. The entire regression model results show that the knowledge and experience block was significant in predicting the SSM. Specifically, a positive relationship between people’s prior experience and the SSM (\( R = .41 \)) was supported. A \( R^2 \) Change of .17 (\( F(5, 93) = 3.71, p < .01 \)) indicated that 16.6% of variance of the SSM can be explained by people’s game topic-related prior experience; that is to
say, people who have more prior experience and knowledge about a certain video game topic are more likely to have a strong SSM when they are playing related games. Moreover, the results also indicated that game playing skill was positively related to the construction of SSMs ($R^2_{\text{Change}} = .061, F(1, 90) = 7.83, p = .01$). In other words, people who have better skill in video games are more likely to build a strong SSM than people who have less skill. One more finding was that people’s attitudes were also found to significantly predict the SSM ($R^2_{\text{Change}} = .07, F(2, 91) = 4.18, p = .012$). Although it was not main purpose of this study, this positive relationship suggests that people who have more positive attitudes toward a game topic and video games are more like to build strong SSMs.

In sum, hypothesis 2 was partially supported by the results, and two more factors, gaming skill and attitudes, were found to have a positive impact on the construction of SSMs.

**Hypothesis 3**

The last hypothesis proposed a positive relationship between congruence and level of spatial presence. Since achieving spatial presence occurs at the second level in the Two Level Process Model of Spatial Presence, the congruence and SSM variables were entered in two blocks in a regression model to predict the dependent variable spatial presence. Based on the results of correlations, both congruence ($r = .42, p < .01$) and SSM ($r = .32, p < .01$) were found to have significantly positive correlations with spatial presence. The Beta coefficients of each variable indicated that congruence had a unique contribution to achieving spatial presence ($\beta = .37, p < .01$); in contrast, SSM was not found to have a significant unique contribution to spatial presence, unexpectedly.
However, considering the whole regression model, the results demonstrated that both congruence and SSM are effective in predicting people’s sense of spatial presence. Specifically, with a $R^2$ Change of .10 ($F (1, 98) = 10.93, p < .01$), a positive relationship between the SSM and level of spatial presence was supported by the results; in other words, people with stronger SSMs are more likely to have higher level of spatial presence, which is also consistent with the relationship suggested by Wirth et al. in the Two Level Process Model of Spatial Presence. Furthermore, after controlling for the SSM, congruence was also found significant in predicting spatial presence, with an $R^2$ Change of .08 ($F (1, 97) = 9.94, p = .00$).

In sum, hypothesis 3 was supported by the results. More congruence resulted in more spatial presence.

**Discussion**

This study examined people’s prior experience and knowledge as factors that may impact their SSM and sense of spatial presence in the Two Level Process Model of Spatial Presence proposed by Wirth et al. (2007). The results somewhat supported the influence of experience. Four types of prior experience, including direct real experience, direct virtual experience, indirect real experience, and indirect virtual experience were examined individually, and only direct real experience was found to contribute significantly and uniquely to the construction of SSMs.

Furthermore, the results indicated that gaming skill plays the most important role in forming SSMs when people play video games. Skill explains a significant amount of variance in an SSM and had the only significant unique contribution when all predictor variables were considered together. Another finding was that people’s attitudes toward video games and game
topics were positively related to the SSM. The results suggest that people who have more positive attitudes toward video games and certain game topics are more likely to construct SSMs when they play related video games, although this may be dependent on skill. The relationship between skill and attitudes toward games bears further exploration in future research.

Regarding factors that may be influential in the process of promoting SSMs to the sensation of spatial presence, one factor, congruence, was found to have a significant impact in achieving spatial presence. A positive relationship between levels of congruence and levels of spatial presence was supported. The study also corroborated the positive relationship between SSMs and spatial presence, which was proposed by Wirth et al. (2007), although congruence was the only variable to make a unique contribution.

**Prior Experience and SSMs**

Due to the importance of the SSM in achieving spatial presence, many researchers have investigated various factors that are potentially essential in forming SSMs. Therefore, a goal of this study was to examine what media user factors can impact SSM construction. In this study, people’s prior experience was proposed to be a critical user factor in the process. The results supported this assumption. People who had more game topic-related experience were more likely to have stronger SSMs when playing related video games. The results also indicated that prior experience individually did not have a significant unique contribution to the SSM. This was mainly because of the correlations among the four types experience. More specific aspects of prior experience, such as context, directness and each type of experience, were also addressed in this study and will now be discussed.
Real experience vs. virtual experience. Not many studies have investigated the impacts of real and virtual experience on people’s mental representations. In one of the few, Arthur, Hancock, and Chrysler (2007) did not find any significant difference in how real and virtual experience affected SSMs. Most previous studies focused on less interactive behaviors to measure impacts of real and virtual, however, such as reading texts or maps. Video game play is a more complex, interactive behavior; therefore, the current study addressed the issue of impact of real and virtual experience on mental models with an expectation of finding a difference between them in a game context.

According to the results, people’s real and virtual experience together explained a significant amount variance of the SSM, which demonstrated that people who have more real and virtual prior experience will be more likely to have strong mental models when they are playing video games related to those experiences. However, regarding the unique contribution of each individual factor, both real and virtual experience did not have significant unique contributions to the construction of an SSM, though the real experience was found to have a larger contribution than the virtual experience. In other words, neither real nor virtual experience individually predicted the SSM.

Although the results of RQ 1 present some contradictions, they are still informative. They suggest that experience is important in constructing SSMs, and that real and virtual experience should be considered together in predictive models. This may be due to a natural relationship between experience types. For example, some people like playing basketball in the real world, which will give them a lot real basketball experience, and these people may also play basketball video games. Although their real and virtual experience together significantly predict their SSMs in game play, it may be difficult to predict SSMs by solely observing either real or virtual
experience. Consistent with this argument, the results show a significant correlation between people’s real and virtual experience \((r = .32, p = .00)\), indicating that people who have more real experience tend to have more virtual experience.

**Direct experience vs. indirect experience.** According to Miller and Miller (1996), attitudes produced by direct experience are more accessible in a consummatory situation, and attitudes formed through indirect experience are more accessible in an instrumental situation. Since playing video games is more like consummatory behaviors, this study proposed that direct experience is more effective than indirect experience in predicting SSMs, and this assumption was supported. This suggests that both people’s direct and indirect experience can successfully predict the construction of SSMs. Specifically, people who have more direct experience and indirect experience together are more likely to have stronger SSMs. Examining unique contributions of direct and indirect experience found that the direct experience had a significant unique contribution in explaining and predicting SSMs; in contrast, there was no significant unique contribution found from indirect experience.

As discussed above, mental models are dynamic, and people can have several different mental models at the same time. On the other hand, if a people spend a lot time with indirect interaction, it will negatively impact his/her available time to do direct interaction. Therefore, when these people are required to play a video game, they may encounter more distractions when in building a gaming SSM due to lack of direct experience with the video game. For example, when a people who often watch a basketball game are asked to play a basketball game, they may be able to build a strong SSM of the game at the beginning since they have a lot experience of watching basketball game. However, because of unfamiliarity with playing the game, they may need to focus more on building mental representation of the game controller so that they can get
a better performance in the game. Such distraction may finally weaken the person’s mental representation of the game. This study found weak support for this idea however and it should be tested further in subsequent research.

**Comparison of four types of prior experience.** Results also indicated that four types of prior experience together significantly impact a person’s SSM. Examining the contribution of four types of experience individually, direct real experience was found to have the largest and only significant unique contribution among them. The finding that direct real prior experience was the most influential in building SSMs is consistent with previous research. The important role of direct real experience in constructing an SSM is consistent with core assumptions of presence, particularly the notion that presence is the perception of the virtual as real. It makes intuitive sense that people who have a higher level of direct real experience with a behavior would have a stronger mental model of the behavior, ultimately leading to presence.

**Gaming Skill and SSMs**

The current study did not address the role of skill in any hypotheses, but the results indicated that gaming skill may be a very important factor in building SSMs. After controlling other variables, 6.1% of variance of the SSM was explained by gaming skill, and it was the only variable to have a unique positive contribution. Some scholars have tested the relationship between player skill and presence, and the current study provided a different perspective to link these two variables based on previous literature. For example, Bracken and Skalski (2005) found a significant positive relationship between players’ skill level and spatial presence experienced while playing a high definition video game. While the current study did not relate skill level directly to spatial presence, it connected skill with SSM, suggesting a mediated relationship.
The finding for skill is also consistent with the Two Level Process Model of Spatial Presence. According to the model, attention plays an important role in building SSMs in the first level. The more attention the players can focus on processing spatial information received from media, the stronger the SSMs they will get at the first level, and finally the higher level the spatial presence they will achieve at the second level (Wirth et al., 2007). However, players with lower gaming skill may have to distribute more attention on remembering functions of buttons on a controller, and figuring out how to control their characters correctly, which will reduce the amount of attention that can be distributed on processing media information and building SSMs. This would likely give them weaker SSMs. Therefore, the result also suggested that game consoles mapping human behaviors more naturally with less certain skills required should be more effective in heightening players’ spatial presence and enjoyment, consistent with recent research (Skalski, Tamborini, Shelton, Buncher, & Lindmark, 2011).

**Congruence and Spatial Presence**

According to the Two Level Process Model of Spatial Presence, media users have to consider SSMs of a media environment formed at the first level as Primary Ego Reference Frame (PERF) so that they can promote to spatial presence at the second level. The current study proposed that congruence can be influential in the process of achieving spatial presence. Specifically, the more congruence between players’ prior experience and current gaming experience, the higher the level of spatial presence they will achieve. Results of this study suggested a positive relationship between level of congruence and level of spatial presence. They also indicated that congruence is the most important factor in the process of forming spatial presence; among all variables, only congruence was found to have a significant unique contribution to forming spatial presence.
The supported relationship provides researchers with more connections among previous literatures. As Reeves and Nash (1996) suggested, humans automatically respond socially and naturally to mediated presentations because the human brain evolved in a world in which only humans exhibited rich social behaviors. Hence, when people encounter any media environments, they will automatically respond to those environments based on prior experience and knowledge. Therefore, they will be upset about it and feel less present if they find that their prior experience and knowledge do not work in an expected manner. For example, if people find that they can make almost every three-point shot in a video game, and get a 80% three-point shot percentage (when the average is closer to 30%-40%), they will probably perceive this as unrealistic even though they may be winning the game, and this incongruence may weaken their sense of spatial presence. However, the effects of congruence may be moderated due to other factors, such as gaming skill.

**Future Research**

Based on the Two Level Process Model of Spatial Presence, the current study added a new component to the model, personal prior experience, which makes the model more effective in explaining media users’ sense of spatial presence. It also found gaming skill to be a strong influence in building an SSM at the first level, and congruence as an effective predictor of spatial presence at the second level. Given the complicated nature of the Wirth et al. spatial presence model, more inquiry is encouraged to shed light on the complex relationship between personal experience and spatial presence. Additional perspectives, such as the MAIN model (Sundar, 2008), which calls attention to how technology affordances (Modality, Agency, Interactivity, and Navigability) trigger heuristics facilitating spatial presence, may be helpful here.
References


http://www.theesa.com/facts/salesandgenre.asp


Table 1. Types of Personal Prior Experience

<table>
<thead>
<tr>
<th>Directness</th>
<th>Context</th>
<th>Real</th>
<th>Virtual</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct</td>
<td></td>
<td>- Direct-Real</td>
<td>- Direct-Virtual</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Personally interacting with an objects occurred in the real word</td>
<td>- Personally interacting with an object occurred in a virtual environment</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Example: Playing basketball</td>
<td>- Example: Playing a basketball video game</td>
</tr>
<tr>
<td>Indirect</td>
<td></td>
<td>- Indirect-Real</td>
<td>- Indirect-Virtual</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Passively experiencing an object in the real world</td>
<td>- Passively experiencing an object in a virtual environment</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Example: Watching someone playing basketball</td>
<td>- Example: Watching someone playing a basketball video game</td>
</tr>
</tbody>
</table>
### Table 2.

Multiple Regression Predicting the SSM from Personal Prior Experience, Gaming Skills, and Attitudes

<table>
<thead>
<tr>
<th>Block #</th>
<th>Variable</th>
<th>r</th>
<th>Final $\beta$</th>
<th>$R^2$ Change</th>
<th>F Change</th>
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<tbody>
<tr>
<td>1</td>
<td>Direct Real</td>
<td>0.38**</td>
<td>0.17</td>
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<tr>
<td></td>
<td>Direct Virtual</td>
<td>0.25*</td>
<td>0.02</td>
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<tr>
<td></td>
<td>Indirect Virtual</td>
<td>0.16</td>
<td>-0.14</td>
<td>0.17</td>
<td>3.71*</td>
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<tr>
<td></td>
<td>Indirect Real</td>
<td>-0.13</td>
<td>0.08</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Knowledge of Basketball</td>
<td>0.28*</td>
<td>0.06</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Attitudes toward Basketball</td>
<td>0.39**</td>
<td>0.22</td>
<td>0.07</td>
<td>4.18*</td>
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<tr>
<td></td>
<td>Attitudes toward Video Games</td>
<td>0.33*</td>
<td>-0.07</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Gaming Skill</td>
<td>0.46*</td>
<td>0.50*</td>
<td>0.06</td>
<td>7.83*</td>
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<td>4</td>
<td>Gender</td>
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<td>-0.13</td>
<td>0.03</td>
<td>1.76</td>
</tr>
<tr>
<td></td>
<td>Age</td>
<td>0.04</td>
<td>0.17</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

$R^2 = .32$, Adjusted $R^2 = .25$, $F(10, 88) = 4.23**$

* Denotes $p< .01$; ** denotes $p< .001$