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THE EFFECTS OF EMOTION, SPATIAL ABILITY, AND VIEW POINT FOR THE SENSE OF TELEPRESENCE IN A 3D COMPUTER GAME ENVIRONMENT

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ABSTRACT

Telepresence or the sense of "being there" has been discussed in the literature as an essential, defining aspect of virtual environments, including definitions rooted in behavioral response, signal detection theory, and philosophy, but has generally ignored the emotional aspects of the virtual experience. The purpose of this study is to examine the concept of telepresence in terms of people's emotion response, spatial ability, and view point engagement within an immersive mediate environment. Two main theoretical statements are discussed: (1). Subject telepresence: emotional factors and spatial ability; (2). Objective telepresence: point of views, in a 3D computer game environment. This study has implications about how research should be conducted to further our understanding of telepresence. Validated psychological subjective techniques for assessing emotions and sense of telepresence will be applied to increase our understanding of virtual experiences. Further understanding of the interaction between telepresence and emotional state will improve our knowledge of the construct of presence as well as better inform us about how a virtual environment, such as a 3D computer game, can be applied in creating and designing emotional effects.

Keywords: *Telepresence; Emotion; Spatial Ability; View Point*

1. INTRODUCTION

Applications of virtual reality technology to advance various fields such as education, communication, health, training, entertainment and the military, have gained extremely high attention recently. In the past, a virtual environment was commonly defined as "electronic simulations of environments experienced via the mounted eye goggles and wired clothing enabling the end user to interact in realistic three-dimensional situations." [1] This definition, however, appears to only be useful for system vendors but not for researchers. Based on this definition, a virtual environment becomes solely a collection of media and machines. As a result, it might hinder the attempt to reveal embedded characteristics that might substantially impact the interaction process in the virtual environment. According to William James [2] "*The world of our experience consists at all times of two parts,*

an objective and a subjective part ..... The objective part is the sum total of whatsoever at any given time we may be thinking of, the subjective part is the inner 'state' in which the thinking comes to pass."(p. 402). Personal experiences are the interaction results between individual mental operations and external contents or structures. As such, Imagination and illusory space have been frequently discussed in the literature as two primary factors in constructing the virtual experience. The former is directed by the users' cognitive processes, while the latter emphasizes a space in which consensual hallucination, mutual acceptance and make-believe can be triggered. Apparently, both depend on the user's mental operations. The experience of virtual reality should in fact be discussed from the user's subjective perspective [3].

It is thus more appropriate to define virtual reality as "a real or simulated environment which is mediated through media and the individual's mental construction to enable telepresence experiences."

2. THEORETICAL FRAMEWORK

2.1. Telepresence

Witmer and Singer [4] defined the immersion experience as *"a psychological state characterized by perceiving oneself to be enveloped by, included in, and interacting with an environment that provides a continuous stream of stimuli and experiences."*(p. 227) According to this definition, telepresence or the sense of "being there", is a critical indicator of immersion experience. From literatures, many scholars [4, 5] also viewed telepresence as an essential, predicted element of an immersion experience. Telepresence is the generic perception of the surrounding environment which involves automatic or controlled mental processes. In other words, virtual realities reside in a user's consciousness [3]. Schloerb [6] proposed that the factors influencing the sense of telepresence can be categorized in terms of two dimensions: (a) objective telepresence, (b) subjective telepresence. Objective telepresence refers to physical facilities or stimuli which allow users to interact with the environment. Subjective telepresence refers to users' characteristics including mental processes and the cognitive tendency to suspend disbelief. Consistently, Lessiter, Freeman, Keogh, and Davidoff [7] also provided similar concept. Telepresence contains two parts: media characteristics and individual characteristics. In the present study, objective and subjective telepresence will be examined respectively in terms of screen viewpoint and emotion as well as spatial ability.

2.2. The screen viewpoints

In a 3D online game environment, the screen viewpoint (1st or 3rd) is one of the most important environmental factors that might affect subjective senses of telepresence [8]. The 1st and 3rd person viewpoints in computer games are often used to describe camera viewpoints. The 1st person viewpoint sets the player's screen display to be the same as the way in which his / her avator sees in the game world. In a sense, it casts players directly into the game environment. As for using the 3rd person viewpoint, players either look over the shoulder of, or look down from certain degrees on, his / her avator to interact with the game world. Rollings and Adams [9] indicated that although the 1st person viewpoint might efficiently immerse gamers into a virtual environment, its limited 30 degrees of field vision is quite different from human eyes which provide up to 120~180 degrees of field vision. Some important cues or information about the surrounding environment might thus be missed and cause serious cognitive problems. In contrast, the 3rd person viewpoint provides players with a wider field vision allowing them to be aware of situations in front of them, as well as to collect information from the rear and both sides. This is considered to provide great help to players, in particular during their tactical thinking [10]. However, this viewpoint might also engender the player's role to switch between actor and observer, which causes inevitable break-down of the immersion experience.

Whether the 1st person viewpoint or the 3rd person viewpoint could enhance a higher sense of telepresence remains largely unknown.

2.3. Emotion

Jonathan and Stacy [11]suggested emotion playing a very important role especially in a virtual gaming environment. It can facilitate players' senses oftelepresence and the illusion of being a game character living inside the game world. Frederic [12] indicated that computer games is actually a mental process. In order to let players immerse into the game scenarios, the game has to capture their attention first to trigger emotional responses, then the flow experience can be achieved at the end. By this process view, emotion is indeed a critical element to mediate the immersion experience. In the past, the immersion experience was often viewed as the result caused by media characteristics [7]. It has been gradually changed, however, to consider emotion and its related mental activities of being the more core issues than hardware technology to impact players' senses oftelepresence [13, 14] In fact, many major telepresence questionnaires not just have items of external context, but also include items of the arousal degree of subjective emotion [15]. In addition, Roberts, Smith, and Pollock [16] proposed three individual factors that might contribute to the sense of telepresence: imagination, emotion, and willing suspension of disbelief. Among these three, emotion have been proposed by many scholars [11, 13, 14, 17, 18] for its potential effect, especially to engage subjects with a 3D virtual environment . Emotion can highly affect individuals' cognitive activities, which in turn deepens their flow experiences. Emotion will be investigated respectively in terms of dimension theory of emotion (arousal, valence, dominance) for their strengths in affecting a sense of telepresence.

Unfortunately, the study results of emotion and telepresence are still very ambiguous and inconsistency [17, 19, 20]. It is thus the primary purpose of the present study to further clarify the relationship between emotion and telepresence.

2.4. Spatial ability

Based on Lang's [21] Limited Capacity Theory, Eveland & Dunwoody [22] proposed four activities of working memory in navigating a virtual environment: orientation, maintenance, elaboration, and evaluation. To ensure successful arrival of the destination, users first have to aware where they are before any decision or strategy can be made for choosing a right path. Then, during the progress, users might apply different strategies like chunking or meaningful connections to store or to maintain necessary information for wayfinding tasks. At the same time, users will elaborate the current situations and plan possible solutions. Evaluation will then follow to confirm whether the solutions being applied achieve expectations. This is a cycle process that consists with Norman's [23] Action Cycle. It involves two primary internal factors: spatial knowledge and spatial ability.

Spatial knowledge is a personal cognitive map or knowledge about the scale of a space in terms of structure and organization. Three types of spatial knowledge that might profoundly affect users' navigation performances [24, 25, 26] are: landmark knowledge, route knowledge, and survey knowledge. Theoretically, landmark knowledge settles the foundation for the construction of the route knowledge that describes the relationships between two locations. Survey knowledge represents the overall conceptual map of a certain space which is constituted by the route knowledge. However, the sequence to acquire these three types of spatial knowledge could be altered by individual cognitive abilities (e.g. spatial ability) and the availabilities of interface technologies (e.g. landmark).

Spatial ability has long been recognized as one the most important cognitive abilities to affect spatial knowledge. It is the ability to manipulate and organize information or objects in a space. As a result, the user's spatial ability and screen viewpoint treatments might saturate his/her emotion response

which might further impact the resource distribution of the subject's working memory as well as spatial knowledge.

2.5. Summary

In sum, the present study aims to examine how an individual might sense telepresence through the mutual interaction between internal and external factors in a 3D game environment. Variables of the personal point of view (objective telepresence), spatial ability (subjective telepresence) will be compared for their effects on the subject's emotional responses and senses of telepresence (Figure 1). To investigate the hypotheses, the present study generated the following research questions:

- Will different screen viewpoints affect players' emotional responses (arousal, valance, dominance) and senses of telepresence (spatial presence, engagement, ecological vailidity / Naturalness, Negative effect)?
- Will players' spatial ability affect their emotional responses (arousal, valance, dominance) and senses of telepresence (spatial presence, engagement, ecological vailidity / Naturalness, Negative effect)?
- Will players' emotional responses (arousal, valance, dominance) affect their senses of telepresence (spatial presence, engagement, ecological vailidity / Naturalness, Negative effect)?
- Will the interaction effects between screen viewpoints and players' spatial ability affect their emotional responses (arousal, valance, dominance) and senses of telepresence (spatial presence, engagement, ecological vailidity / Naturalness, Negative effect)?

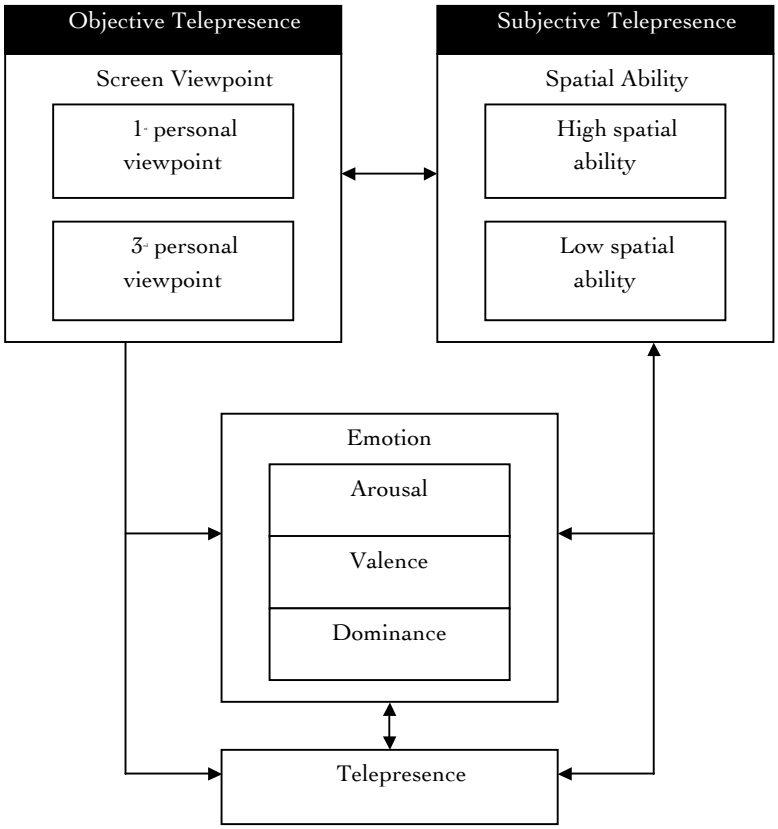

Figure 1: Research Conceptual Model

3. METHODOLOGY

A fixed model of the 2x2 CRF-pq design (Table 1) and the two-way ANOVA analysis will be used to examine the hypotheses in this study. Table 1 shows how the data will be laid out for this analysis. There are two independent variables. First is subjects' spatial ability which is identified by Spatial Ability Scale [27] and the second independent variable is the interface of 1st screen viewpoint and 3rd screen viewpoint. An award-winning authentic racing game, Need for Speed™ Underground II (http://undercover.needforspeed.com/home.action), is selected to be the primary experimental environment based on the gaming content and the viewpoint interfaces fit with the study purposes of the present study (Figure 2). Self-Assessment Manikin (SAM) [28] will be managed to measure subjects' emotional responses in terms of arousal, valence, and dominance. A new state questionnaire measure, ITC Sense of Presence Inventory (ITC-SOPI) [7], developed informed by previous research on the determinants of telepresence and current self-report measures are used to collect subjects' senses oftelepresence.

Upon arrival, participants were given the Spatial Ability Scale to identify their spatial abilities. Then, the researcher randomly assigned these participants into the 1st viewpoint interface group (1st VI) and the 3rd viewpoint interface group (3rd VI). Each group included approximate numbers of high spatial ability and low spatial ability participants. According to the assigned group, a tutorial web page was loaded onto the subject's computer screen and started a 3-minute practice session to master the interface operation. Without further questions, participants proceeded to the formal experimental stage. Subjects were required to complete a ten run of racing mission in 5 minutes. The goal of the racing mission is to drive fast and get as many scores as they can. After the racing session, participants immediately moved on to answer Self-Assessment Manikin (SAM) and ITC Sense of Presence Inventory (ITC-SOPI). The average time required to complete the experiment was 40 minutes.

Table 1: The diagram for 2x2 CRF-pq design

		Interface	
		1st screen viewpoint	3rd screen viewpoint
Spatial Ability	High	X	x
	Low	X	x

1st screen viewpoint	**3rd screen viewpoint**
	

Figure 2: 1st screen viewpoint and 3rd screen viewpoint

4. RESULTS AND CONCLUSION

From the experiment results, neither the 1st screen viewpoint nor the 3rd screen viewpoint could substantially affect any senses of players' telepresence. However, 1st screen viewpoint did possess significant effect to impact players' emotions in both valance (F=10.843, p=.002) and dominance (F= 8.599, p= .005) dimensions. For the effect of the player's spatial ability, in the group of using 1st screen viewpoint, players with high spatial ability significantly appeared higher ecological validity / naturalness of telepresence (F = 7.611, p=.010), while no other significant result was found when compared these two spatial ability types of players in terms of spatial presence, engagement, and negative effect of telepresence dimensions.

Subjects with positive emotion could significantly sense higher spatial presence (F=3.381, p=.041) and ecological validity / naturalness (F=3.228, p=.042) of telepresence; in comparing to subject with lower emotional arousal, subjects with higher emotional arousal apparently can sense spatial presence (F=2.299, p=.049), engagement (F=2.118, p=.050), ecological validity / naturalness (F=2.906, p=.043), and negative effect (F=2.770, p=.044) of telepresence; as for players with higher dominance emotion, the study results showed that they could significantly sense telepresence in both dimensions of spatial presence (F=4.717, p=.025) and engagement (F=3.079, p=.039). For the interaction effects, by using the 3rd screen viewpoint, players with high spatial ability demonstrated significant highly engagement and lower negative effect. Their senses of spatial presence and ecological validity / naturalness were no different comparing with low spatial ability players. Another interesting finding was that the 3rd screen viewpoint made both types (high and low) of spatial ability.

To compare players with high spatial ability who using either 1st or 3rd screen viewpoint, the 1st screen viewpoint can create much higher effect than the 3rd screen viewpoint in the engagement (F=7.077, p=.021) and ecological validity / naturalness (F=12.684, p=.0004) dimensions of telepresence. Additionally, the 1st screen viewpoint was very capable to increase the dominance part (F=2.627, p=.031) of emotion of the high spatial ability players. As for the low spatial ability players, except the 3rd screen viewpoint apparently facilitated them to experience the spatial presence (F=7.062, p=.021), no matter which type of screen viewpoint was using during the racing missions, all created the similar senses of telepresence. That is, to compare with the limited vision field of 1st screen viewpoint, the 3rd screen viewpoint can provide wider field vision which did help low spatial ability players of being more easily to cast themselves into the game space. However, the 1st screen viewpoint can cause higher valance (F=2.084, p=.047) and arousal (F=4.115, p=.017) emotional responses especially for the low spatial ability players.

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