The Study on Optimization of Virtual Presence for Computer-Game Design

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Abstract

A game creates a subjective and deliberately simplified representation of emotional reality. A game is not an objectively accurate representation of reality; objective accuracy is only necessary to the extent required to support the player's fantasy. The player's fantasy is the key agent in making the game psychologically real. And we can call the fantasy representation in the light of subjective face "the feeling of presence" The study of Mel Slater describes an experiment to assess the influence of immersion and presence on performance in immerse virtual environments. The task involved Tri-Dimensional Chess game, and required subjects to reproduce on a real chess board, the state of board learned from a sequence of moves witnessed in a virtual environment. In this paper we have distinguished between immersion and presence, and considered the relationship of these to performance and immersion of gaming. And we found that as for computer design, we should be designed to consider inter-relationship among background configuration, spatial recognition and screen interface design by gender and personality.

1. Subjective Representation and the Feeling of Presence in Game Design

It is said that games will never be as popular as movies, because games draw people in just because of the rewards they offer, not because they portray any ideas through their game play. At first, game users are sucked into the world then it just becomes repetitive. The story and characters lose their meaning and instead, become abstract objects on your way to winning just like a board game or sport. Let us look at *Diablo*: at first you enter this cool new world and you feel the compelling idea that the designer is sharing with you. It's a different world, but by the time you've killed your five hundredth Elemental, you are no longer conscious of this idea. Game Users are simply playing for the rewards which are like gold, new weapons and new abilities. That is why Game represents life and world. Real life and world is composed of not only the tangible such as geography and space but also the intangible such as behavior, reward and rule. It is likewise that when you move to California from Texas, you first are impressed by perfect weather and space, but no later than several months you would fall in thought of your salary and fare for the living in California.

We have to say that a game is a closed formal system which subjectively represents a subset of reality. Let us examine each term of this statement carefully. 'Closed' means that the game is complete and self-sufficient as a structure. The model world created by the game is internally complete; no reference need be made to agents outside of the game. Some badly designed games fail to meet this requirement. Such games produce disputes over the rules, for they allow situations to develop that the rules do not address. The players must then extend the rules to cover the situation in which they find themselves. This situation always produces arguments. A properly designed game precludes this possibility; it is closed because the rules cover all contingencies encountered in the game. 'Formal' means only that the game has explicit rules. There are informal games in which the rules are loosely stated or deliberately vague. Such games are far removed from the mainstream of game play.

Representation is a coin with two faces: an objective face and a subjective face. The two faces are not mutually exclusive, for the subjective reality springs from and feeds on objective reality. In a game, these two faces are intertwined, with emphasis on the subjective face. For example, when a player blasts hundreds of alien invaders, nobody believes that his recreation directly mirrors the objective world. However, the game may be a very real metaphor for the player's perception of his world. Clearly something more than a simple blasting of alien monsters is going on in the mind of the player. We need not concern ourselves with its exact nature; for the moment it is entirely adequate to realize that the player does perceive the game to represent something from his private fantasy world. Thus, a game represents something from subjective reality, not objective. Games are objectively unreal in that they do not physically recreate the situations they represent, yet they are subjectively real to the player. The agent that transforms an objectively unreal situation into a subjectively real one is human fantasy. Fantasy thus plays a vital role in any game situation. A game creates a fantasy representation, not a scientific model. A game creates a subjective and deliberately simplified representation of emotional reality. A game is not an objectively accurate representation of reality; objective accuracy is only necessary to the extent required to support the player's fantasy. The player's fantasy is the key agent in making the game psychologically real. And we can call the fantasy representation in the light of subjective face "the feeling of presence"

2. Subset reality, sensory gratification and game design

A game that represents too large a subset of reality defies the player's comprehension and becomes almost indistinguishable from life itself, robbing the game of one of its most appealing factors, its focus. The distinction between objective representation and subjective representation is made clear by a consideration of the differences between simulations and games. A simulation is a serious attempt to accurately represent a real phenomenon in another, more malleable form. A game is an artistically simplified representation of a phenomenon. The simulations designer simplifies reluctantly and only as a concession to material and intellectual limitations. The game designer simplifies deliberately in order to focus the player's attention on those factors the designer judges to be important. The fundamental difference between the two lies in their purposes. A simulation is created for computational or evaluative purposes; a game is created for educational or entertainment purposes.(There is a middle ground where training simulations blend into educational games.)

Meanwhile, sensory gratification is another important enjoyment factor. Good graphics, color, animation, and sound are all valued by game players. They support the fantasy of the game by providing sensory "proof" of the game's reality. We see a related phenomenon in the movies: special effects. Some of the newer movies have excited great interest because of the excellent special effects they utilize. These movies have placed us in the thick of space battles, let us meet strange and wonderful creatures, and taken us to faraway places. The things we see look so real that we believe the fantasy; we know (subjectively) that the fantasy is real. Similar processes can be applied to games. Special effects, graphics, sound, animation-these factors all help distinguish a good game from a bad game. We must not confuse their role, however; sensory gratification is a crucial support function, not a central feature. Sensory texture enhances the impact of the fantasy created by the game or movie, but wonderful graphics or sound do not by themselves make the product. A movie without a believable or enjoyable fantasy is just a collection of pretty pictures; a game without an entertaining fantasy is just a collection of interactive pretty pictures.

Consider, for example, the differences between a flight simulator program for a personal computer and the coin op game RED BARON". Both programs concern flying an airplane; both operate on microcomputer systems. The flight simulator demonstrates many of the technical aspects of flying: stalls, rolls, and spins, for example RED BARON has none of these. Indeed, the aircraft that the player files in RED BARON is quite unrealistic. It cannot be stalled, rolled, spun, or dived into the ground. When the stick is released it automatically rights itself. It is incorrect to conclude from these observations that RED BARON is inferior to the flight simulator. RED BARON is not a game about realistic flying; it is a game about flying and shooting and avoiding being shot. The inclusion of technical details of flying would distract most players from the other aspects of the game. The designers of RED BARON quite correctly stripped out technical details of flight to focus the player's attention on the combat aspects of the game. The absence of these technical details from RED BARON is not a liability but an asset, for it provides focus to the game.

3. Presence and Game Design: Simulator game and Computer game

There can be a number of physiological effects of experiencing virtual environments. Some researchers have suggested that an illusion of presence creates higher levels of arousal. There have also been demonstrations of various automatic responses to the virtual stimuli, such as ducking when looming objects are presented. The most notable physiological effects, however, are "vection", an illusion of self-motion, and sickness (Prothero et al., 1995). "Simulator sickness" is a common occurrence that appears to be related to a mismatch of sensory inputs that occurs with some virtual environments. One simplistic theory suggests that simulator sickness is caused by a mismatch of the kinetic and visual senses. When the motion and visual sensations do not match the body assumes that it has been poisoned, since poisons produce similar symptoms, and takes the most appropriate action (vomiting). This suggests that high-quality systems that ensure a good correlation between the kinetic and visual senses should be less prone to sickness problems. Simulator sickness is a serious problem that must be solved before immersive technologies can be widely adopted.

There are also psychological effects of virtual environments. VEs are said to produce more enjoyment and involvement than other media types. Material viewed using virtual technology is supposed to be more memorable and more persuasive (Kim & Biocca, 1997). In addition, working in virtual environments is thought to lead to better task performance, and better skills training. A psychological effect of particular interest is desensitisation to the stimuli experienced in a virtual environment. This is being exploited in research on the treatment of phobias, where people are better able to deal with the phobic stimuli (e.g., snakes or spiders) after they are experienced in an immersive virtual environment.

4. Case Study of Mel Slater: An Experiment using Tri-Dimensional Chess Game

The study of Mel Slater describes an experiment to assess the influence of immersion on performance in immersive virtual environments. The task involved Tri-Dimensional Chess, and required subjects to reproduce on a real chess board the state of board learned from a sequence of moves witnessed in a virtual environment. Twenty four subjects were allocated to a factorial design consisting of two levels of immersion (exocentric screen based, and egocentric HMD based), and two kinds of environment (plain and realistic. The results suggest that egocentric subjects performed better than exocentric, and those in the more realistic environment performed better than those in the less realistic environment. Previous knowledge of chess, and amount of virtual practice were also significant, and may be considered as control variables to equalise these factors amongst the subjects. Other things being equal, males remembered the moves better than females, although female performance improved with higher spatial ability test score.

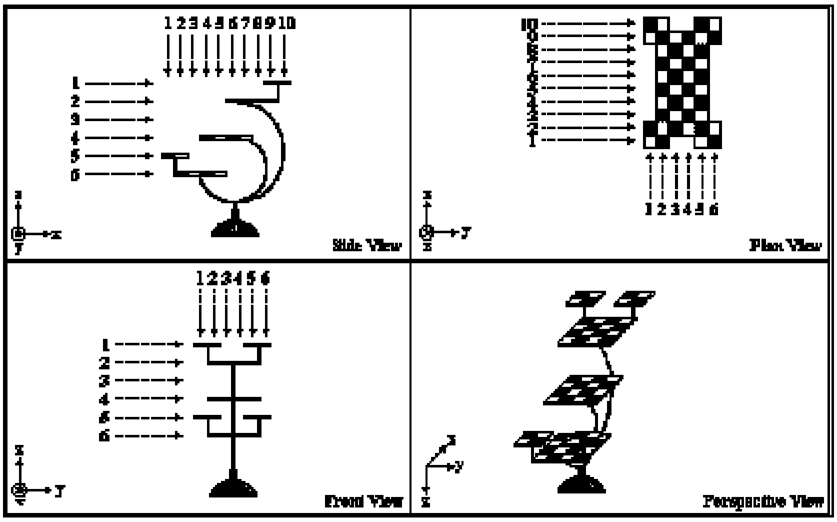

Figure 1
Tri-Dimensional Chess Game

4.1 Background of Experiment: Tri-Dimensional Chess Game

Tri-Dimensional Chess (TDC) is a board game which has many characteristics in common with conventional chess . More specifically, it is a type of chess played on a number of boards suspended at a different heights. The pieces used in this game are the same as conventional chess and capable of the same movements, but also may be moved from one board to another. Moreover, the layout of the different boards is irregular, and the initial positions of the sixteen pieces of each side are different than in conventional chess. Finally, TDC has a set of four movable attack boards, which are also considered to be pieces, and can be moved according to certain rules (Figure 1).

TDC was chosen because it provides a complex geometrical structure and it is this complexity of the layout of the boards and the pieces, which make it a suitable vehicle for the study. The actual rules of the game were of no importance for this experiment. Twenty four subjects were chosen for the experiment according to the factorial design of Table 1.

Table 1: Number of Subjects Per Cell in the Factorial Design

Immersion	Exocentric: 7 moves	Exocentric: 9 moves	Egocentric: 7 moves	Egocentric: 9 moves

Plain	3	3	3	3
Garden	3	3	3	3

4.2 Factorial Design Examples

(a) Immersion: Exocentric/Egocentric

This factor relates to the surrounding aspect of immersion discussed above. Half of the subjects were immersed with an egocentric view into a virtual environment. This was achieved using a DIVISION ProVision100, with a Virtual Research Flight Helmet and a DIVISION 3D Mouse. Polhemus Fastrak sensors were used for position tracking of the head and the mouse. The generated image has a resolution of 704x480 which is relayed to two colour LCDs each with a 360¥240 resolution. The HMD provides a horizontal field of view of about 75 degrees, and about 40 degrees vertically. Forward movement in the VE is accomplished by pressing a left thumb button on the 3D mouse, and backward movement with a right thumb button. A virtual hand was slaved to the 3D mouse - there was no virtual body representation other than this. Objects could be touched by the hand and grabbed by using the trigger finger button on the 3D mouse.

The other 12 subjects experienced the VE from an exocentric view. In order to keep all conditions as similar as possible apart from egocentric or exocentric, the exocentric subjects used exactly the same system, except that they viewed the images on a TV screen. They controlled movement by the 3D mouse. This time the HMD was placed on the left shoulder of the subject so that viewpoint could be controlled with the left hand.

One condition could not be controlled - the resolution of the different displays (HMD and TV screen). The image generated from the same source as the HMD had a resolution of 704¥480 which was fed to an NTSC 3.58 28 inch TV. Hence the exocentric group observed a higher resolution display.

(b) Environment: Plain/Garden

The environment factor is related to vividness. Half of the subjects ("garden") participated in an environment where the TDC system was located in a realistic setting. This consisted of an open field, populated by a table, a chair, a tree and small plant. The TDC board was located on the table. This model had a large horizontal plane forming the ground, and a spherical cone representing the sky. This was called the "garden" environment. All surfaces in the VE garden were appropriately texture mapped. The remaining subjects ("plain") saw the TDC game suspended in a void. Examples of these environments are shown in the colour plates.

(c) Number of Moves

Each subject had to witness the first few moves of a computer versus computer game. The number of moves was either 7 or 9, to give tasks of slightly differing degrees of complexity. The subject was responsible for initiating the sequence of moves, as well as "instructing" each consecutive move. To be more precise, the subject had to initiate this game by pressing a red button situated next to the base of the virtual TDC. As soon as the button was pressed, one of the pieces on the board would change its colour to bright red, indicating the first computer move. The move was not performed by the computer until the subject decided to "instruct" the computer to do so. To give this instruction, the subject had to touch the red piece with the virtual hand. Doing this caused the piece to leave its current position and move to a new position on the board. As soon as this piece moved to its new position, another piece on the board changed its colour to bright red. The subject had then to touch this piece in order to make it move to its new position on the board, following a predetermined path. Another piece would then in turn change to bright red, and so on. This process carried on for a certain number of moves - 7 or 9. When the subject could not find any other bright red piece on the board the sequence had finished. The subject could repeat the identical complete sequence from the beginning by again pressing the red button.

The task of the subject was to remember which pieces were moved and where they were moved to. They then had to reproduce the final state of the board on the real life TDC board from which the virtual TDC had been modeled. There was no limit to the amount of times a subject could repeat the sequence of moves. This was done so that different rates of learning between the subjects be eliminated as a source of experimental variation. The importance of feeling confident in being able to accurately reproduce the moves in real life was clearly explained to each subject, and the main experiment did not commence until the subject confirmed a high degree of confidence.

4.3 Virtual Model and Performance

The boards and pieces were modeled in AutoCAD. There were on the average 290 vertices and 230 triangles in each chess piece. The entire board, including the board base, the bottom, middle, and top boards, the attack-boards, and the poles suspending the attack-boards consisted of 438 vertices and 344 triangles, all texture mapped. The activation button consisted of 56 vertices and 42 triangles. The garden, including a table, a chair, a plant, a tree, a ground, and a sky-dome, consisted of 2543 vertices and 1456 triangles, all texture mapped. Altogether there were a total of 7732 triangles in the garden environment and 6276 in the plain environment (consisting only of the TDC system). Further description of the process of object construction can be found in in (Linakis, 1995).

The frame rate offered on the ProVision system is not guaranteed at any particular level of performance. It varied between 15 and 20Hz depending on the complexity of the data in view at any particular time. Clearly subjects in the plain environment would have generally experienced a faster frame rate than those in the garden environment. This does confound the experiment to some extent since on the one hand the more realistic environment is, in the terminology of this paper, a more "immersive" one, yet its lower frame rate makes it less immersive. However, an experiment of Barfield and Hendrix (1995) found that frame rates of between 15 and 20Hz resulted in the same degree of reported "presence".

4.4 Interpretation of Results

The results suggest the following - that other things being equal:

- Performance as measured in this particular experiment is positively associated with egocentric immersion in comparison with the exocentric screen based viewpoint;

- Performance is positively associated with a more realistic (garden) environment compared with an empty environment;

- Females do not do as well as males in this particular experiment, but

- In the case of females a higher SAT score is associated with increased performance, whereas for males the SAT score is not associated with performance.

These results also take into account that (other things being equal):

- Previous knowledge of chess is associated with better performance;
- Better performance is achieved the greater the number of practice sequences.

5. Conclusion: the Implication to Computer Game Design

In this paper we have distinguished between immersion and presence, and considered the relationship of these to performance and immersion of gaming. We have argued that immersion is a description of a technology, whereas presence is concerned with the concomitant behavioral and psychological responses of people. In discussions of "performance" in relation to VEs it should always be clear as to whether the performance relates to efficiency regarding the performance of some task within the VE or in the real world subsequent to a VE experience. Increased immersion may well improve performance in certain tasks due to the higher quality and quantity of information available. Presence is concerned with how well a person's behavior in the VE matches their behavior in similar circumstances in real life, rather than with how well they perform as such.

We can carry out a case-control experiment to study the relation between immersion and performance for a task involving comprehension and memory of a complex 3D object that particularly is 3D computer game world. The tacit results might suggest that increased immersion (egocentric rather than exocentric viewpoint, and greater vividness in terms of richness of the portrayed environment) do indeed improve entertaining task performance of 3D game. The results take into account relevant background knowledge (chess experiences) and possible gender and spatial ability differences. They also take into account possible differences in learning speed (practice). It is sometimes suggested that females are less good at spatial reasoning than males. This study suggests that the better females are at spatial reasoning, the better their performance in this experiment. So Game designer should consider the easy access at initial stage of playing 3Dgame for women.

The study also suggested that spatial recognition is different from Cell phone embedded game with small screen and Computer game with large Screen. So the targeting of customer especially in gender division is first consideration of game design in configuration of background setting(like the difference of performance between garden and plain) and coloring.

References

Barfield, W., & Webhorst, S. (1993). The sense of presence with virtual environments: A conceptual framework. *Proceedings of the Fifth International Conference on Human-Computer Interaction*, 699-704.

Biocca, F., & Levy, M.R. (1995). *Communication in the age of virtual reality.* Hillsdale, N.J.: Lawrence Erlbaum Associates.

Bocker, M., & Muhlbach, L. (1993). Communicative presence in videocommunications. *Proceedings of the Human Factors and Ergonomics Society 37th Annual Meeting.* Santa Monica, CA: The Human Factors and Ergonomics Society. pp. 249-253.

Carroll, J.M. (1997). Human-computer interaction: Psychology as a science of design. *International Journal of Human-Computer Studies, 46,* 501-522.

Ellis, S.R. (1996). Presence of mind: A reaction to Thomas Sheridan's "Further musing on the psychophysics of presence". *Presence, 5(2),* 247-259.

Gleitman, H. (1986). *Psychology* (Second Edition). New York: Norton.

Heeter, C. (1992). Being there: The subjective experience of presence. *Presence, 1(2),* 262-271.

Held. R.M., & Durlach, N.I. (1992). Telepresence. *Presence, 1(1),* 109-112.

Hendrix, C., & Barfield, W. (1996a). Presence within virtual environments as a function of visual display parameters. *Presence, 5(3),* 274-289.

Hendrix, C., & Barfield, W. (1996b). The sense of presence with auditory virtual environments. *Presence, 5(3),* 290-301.

Hoffman, H.G., Hullfish, K.C., & Houston, S.J. (1995). Virtual reality monitoring. In *Proceedings of Virtual Reality Annual International Symposium (VRAIS),* March 11-15, Research Triangle Park, North Carolina. Los Alamitos, CA: IEEE Computer Society Press.

Hullfish, K.C. (1996). *Virtual reality monitoring: How real is virtual reality?* Unpublished M.Sc. Thesis, Department of Engineering, University of Washington. Available: http://www.hitl.washington.edu/publications/hullfish/

Johnson, M.K, Raye, C.L., Foley, H.J., & Foley, M.A. (1981). Cognitive operations and decision bias in reality monitoring. *American Journal of Psychology, 94(1)*, 37-64.

Johnson, M.K., Hashtroudi, S., & Lindsay, D.S. (1993). Source monitoring. *Psychological Bulletin, 114(1)*, 3-28.

Kim, T., & Biocca, F. (1997). Telepresence via television: Two dimensions of telepresence may have different connections to memory and persuasion. *Journal of Computer-Mediated Communication, 3(2)* [Online]. Available: http://www.ascusc.org/jcmc/vol3/issue2/kim.html

Lombard, M., & Ditton, T. (1997). At the heart of it all: The concept of presence. *Journal of Computer-Mediated Communication, 3(2)* [Online]. Available: http://www.ascusc.org/jcmc/vol3/issue2/lombard.html

Muhlbach, L., Bocker, M., & Prussog, A. (1995). Telepresence in videocommunications: A study on stereoscopy and individual eye contact. *Human Factors, 37(2)*, 290-305.

Prothero, J, Parker, D, Furness, T & Wells, M (1995). Towards a robust, quantitative measure for presence. In *Proceedings of the Conference on Experimental Analysis and Measurement of Situation Awareness*, 359-366. Available: http://www.hitl.washington.edu/publications/p-95-8/

Roberts, L.D., Smith, L.M., & Pollock, C. (1996). *Exploring virtuality: Telepresence in text-based virtual environments.* Paper presented at the Cybermind Conference, Curtin University of Technology, Perth, Australia. Available: http://psych.curtin.edu.au/people/robertsl/Telep.htm

Schloerb, D.W. (1995). A quantitative measure of telepresence. *Presence, 4(1)*, 64-80.

Sheridan, T.B. (1992). Musings on telepresence and virtual presence. *Presence, 1(1)*, 120-126.

Sheridan, T.B. (1996). Further musing on the psychophysics of presence. *Presence, 5(2)*, 241-246.

Slater, M., & Wilbur, S. (1997). A framework for immersive virtual environments (FIVE): Speculations on the role of presence in virtual environments. *Presence, 6(6)*, 603-616.

Strickland, D., & Chartier, D. (1997). EEG measurements in a virtual reality headset. *Presence, 6(5)*, 581-589.

Towell, J., & Towell, E. (1997). Presence in text-based networked virtual environments or "MUDS". *Presence, 6(5)*, 590-595.

Waters, D., & Barrus, J. (1997). The rise of shared virtual environments. *IEEE Spectrum*, March.

Webster's New Collegiate Dictionary. (1981). Toronto: Thomas Allen & Son.

Welch, R.B., Blackmon, T.T., Lui, A., Mellers, B.A., & Stark, L.W. (1996). The effects of pictorial realism, delay of visual feedback, and observer interactivity on the subjective sense of presence. *Presence, 5(3)*, 263-273.

Zeltzer, D. (1992). Autonomy, interaction, and presence. *Presence, 1(1)*, 127-132.