

PRESENCE IN COMPUTER GAMES: DESIGN REQUIREMENTS

Barbaros Bostan
Yeditepe University
Kayisdagi Cad. 26 Agustos Campus
Atasehir, Istanbul / Turkey, 34755
E-mail: bbostan@yeditepe.edu.tr

Sertac Ogut
Marmara University
Faculty of Communication, Nisantasi Campus
Sisli, Istanbul / Turkey, 34365
E-mail: sertacogut@marun.edu.tr

INTRODUCTION

Presence or the sense of 'being there' is an important and critical concept of computer gaming which relies on several factors. When we look at presence from a bottom-up approach to define its components, it is important to identify the design requirements for virtual environments and their effects on presence (Bostan, 2009). It is also imperative to define how much each requirement correlates with presence and how designers should address these. This study aims to solve these issues by using a presence questionnaire based on virtual environment design requirements defined by Stuart (2001).

Data collected from a survey study on a computer role playing game (RPG), which is available for 3663 participants, is used to identify the relationship between these design requirements and presence. Among the selected requirements; sociability, veridicality, autonomy and physics of the virtual world have the highest correlations with presence respectively; and interactivity is a separately analyzed requirement that has special focus on it. Results of the study indicated that, storyline, NPC (non-player character) characteristics and communication with these virtual characters are the most important factors that influence interactivity.

PRESENCE AND DESIGN REQUIREMENTS

Presence, which is defined as the subjective experience of being there, is a construct with various dimensions. In order to define the determinants of presence, Insko (2003) defined three categories of methods commonly used for measuring presence: Subjective measures, behavioral measures and physiological measures. Subjective measures rely on user responses obtained from questionnaires. Various conceptual studies on the nature of presence have been conducted by researchers (Sheridan, 1992; Held & Durlach, 1992) and several of them have used questionnaires to shed light on the dimensions of presence. Lombard & Ditton (1997) defined six interrelated but distinct dimensions of presence: Social richness, realism, transportation, immersion, social actor within medium and medium as social actor. Witmer & Singer (1998) presented 4 factors that contributed to a sense of presence: Control factors, sensory factors, distraction factors and realism factors. Regenbrecht (1998) defined a 3-factor solution for presence: Spatial presence, involvement and realness. Lessiter (2001) extracted 4 factors that influence presence: Physical presence, engagement, naturalness and negative effects.

These studies focus on the hypothesized factors that influence presence in virtual environments. Virtual environment design, however, relies on several requirements. When we look at presence from a requirements perspective,

it is important to identify the design requirements for virtual environments and their effect on presence. This study aims to solve these issues by using a presence questionnaire based on virtual environment design requirements defined by Stuart (2001). Participants of this study are computer game players. According to Steinkuehler (2006), computer games are a productive context for research about cognition and culture in a world that is increasingly globalized and networked. According to Ondrejka (2006), since computer game players spend significant portions of their lives immersed within virtual worlds, computer games provide virtually limitless opportunities for research and study. The computer game selected for this study is a role playing game (RPG).

A RPG is an interactive story where the game player controls an avatar called a player character (PC). The ancestors of RPGs are MUDs, which are text based fantasy worlds that were very popular in the past. Over time, MUDs evolved into standalone RPGs and MMORPGs. Since Towell & Towell (1997) stated that research on MUDs may be helpful in understanding the contribution to presence by social interaction in other virtual environments, studies on RPGs may also provide new insights on the concept of presence. Supported by the story, settings and combat systems of tabletop role-playing games, computer RPGs provide interesting interactivity and openness opportunities to players. Selected RPG, Elder Scrolls IV: Oblivion, is an outstanding game of the genre, combining real world physics with 1500 AI supported virtual characters that have a 24-hour schedule of their own.

Stuart (2001) defined 22 functional requirements for designing virtual environments. All these requirements are of varying degree of importance depending upon the application in question. Stuart's framework is applicable to virtual environments and computer games since it explains important parameters for virtual environment design, but it fails to cover some important characteristics of virtual environments which require special attention and further explanation.

The three I's of virtual reality defined by Heim (1998): Information Density, Interactivity and Immersion, are crucial parameters for virtual environment designers. Information intensity, similar to the requirement of resolution in Stuart's framework, represents the level of detail resulting from the continuous information transfer from the virtual world.

Interactivity is defined by Rafaeli (1988) as an underdefined concept that has little consensus on its meaning, but researchers stated that interaction and interactivity have an important role in creating a sense of presence (Zahorik & Jenison, 1998 ; Sheridan 1992). According to Laurel (1993), interactivity is characterized with three variables: frequency, range and significance of interactions. According to Friedl

(2003), interactivity in computer games has three dimensions: player-to-player, player-to-computer and player-to-game interactions. Player-to-player interaction is unique for multiplayer games.

Immersion is defined by Slater & Wilbur (1997) as a VR system's ability to deliver a surrounding environment, capable of shutting down the sensations from the real world. According to Ermi & Mäyrä (2005), immersion in computer games has three dimensions. Sensory immersion is related to audiovisual properties of the virtual world, challenge-based immersion is related with mental skills such as strategic thinking or logical problem solving, and imaginative immersion is related with the storyline and virtual characters. Comments of a 48 year old gamer obtained by this study can better emphasize the degree of mental immersion experienced by an Oblivion fan: “*I suffer from an immune disease that causes a considerable amount of pain. In the evenings after work, I use Oblivion to detach my mind from the pain and in turn do not require medication while immersed in the game environment.*”

Since the requirements defined by Stuart do not need to be addressed in every application and system, they are classified into two groups: General requirements and special requirements. General requirements are mandatory for every virtual environment and special requirements are optional considerations for the designer. Requirements of Stuart's framework are given below. Only those with an asterisk are taken into consideration for this study. Discussing the specifics of each variable is beyond the scope of this article, but those interested in them can consult (Bostan, 2009) who discussed these requirements in relation to presence.

Table 1: Design Requirements of Stuart (2001)

General requirements	Special Requirements
Interactivity *	Responsiveness
Sociability *	Stability
Veridicality *	Robustness
Presence *	Registration
Resolution *	Calibration and
Representation of User *	Customization
Navigation Techniques *	Reconfigurability
Physics of the Virtual World *	Degree of Virtuality
Viewpoint	Connectivity *
Autonomy *	I/O Bandwidth
Locus of Control *	Safety and Hygiene
Multisensory Requirements	Choice of Representation

RESEARCH FINDINGS

The presence questionnaire developed for this study consists of 10 questions, one of which measures presence as the core concept of this research and the other 9 questions are used to measure the relevancy of selected application requirements with presence. According to Slater (1999), in order to study the factors that influence presence and their relationships with it, presence questionnaires shall include a direct question about presence. Otherwise, questions will give no information about the influence of variables on presence.

The questionnaire, which uses a 5-point likert scale, was posted on the Web. Messages about this study were posted on 13 forums and administrators of various Oblivion fan sites are contacted via e-mail. Several websites announced the questionnaire in their websites, requesting their visitors to participate in this study. The questionnaire was online for 23 days, after which it gets a total of 8065 views and 258 posts in 13 forums. At the end of 23 days, data are available for 3663 participants. Web server statistics show that 6256 people visited the web page of the questionnaire, indicating a 58% response rate.

Table 2: Forum Statistics

Forum Website	Views	Posts
Official Forums	4981	118
Cyrodil Forums	337	19
Planet Elder Scrolls	962	43
Elder Scrolls (co.uk)	58	3
Dark Brotherhood	313	32
FileFront	221	4
Oblivion Files	72	3
Rough Guide to Cyrodil	78	4
Elderscrolls Oblivion	242	9
Canadian Ice	153	9
Blood and Shadows	93	4
Gaming Source	305	4
RPGDot	250	6
TOTAL	8065	258

Demographic Variables

When we take a look at the demographic variables, we see that approximately 5% of the respondents is female, 95% male. The mean age was 24.2, ranging from 10 to 71 years. 19.5% of the respondents are married, 80.5% single. Education levels are, 32.2% high school or below, 31.8% some college or vocational school, 24.3% bachelors degree and 11.7% with a graduate degree.

One-way ANOVA test performed on demographic variables show that age and educational level differences between groups of participants are significant in terms of presence. Levene's test is used as a post-hoc test to validate the assumption of homogeneity of variances between groups. This assumption is not violated since Levene's test is insignificant for age ($p=.227$) and education level ($p=.544$). ANOVA is significant for age ($p<.001$) and education levels ($p<.001$), showing that degree of presence decreases as age and education levels increase.

When we analyze correlations, significant Pearson correlation coefficient ($r= -.064$, p (two-tailed) $<.001$) shows that there is a significant negative relationship between age and presence. Nonparametric correlation tests, Spearman correlation ($r_s = -.104$, p (two tailed) $< .001$) and Kendall's tau ($\tau = -.078$, p (two tailed) $<.001$), are also significant. So, presence decreases with age. Chi-square test between

presence and education level is also significant ($p < .001$) indicating that presence decreases with education level.

Correlation of Design Requirements

In order to define the relationships between the design requirements and presence, parametric and non-parametric correlations of these variables are calculated. Pearson correlation is a parametric statistic with an underlying assumption of normality. When linear correlations are not strong enough, non-parametric correlations give more meaningful but less powerful results. Given below is the correlation table showing that, 8 of the 9 requirements are significantly correlated with presence, confirming their relationships. Among these, sociability, autonomy, veridicality and physics of the virtual world, are the most influencing requirements respectively.

Table 3: Correlation of Design Requirements with Presence

Design Requirement	Pearson (r)	Kendall's tau (τ)	Spearman's rho (r_s)
Sociability	.466 **	.385 **	.457 **
Veridicality	.348 **	.289 **	.344 **
Autonomy	.294 **	.240 **	.286 **
Physics of the Virtual World	.226 **	.188 **	.222 **
Representation of the User	.140 **	.108 **	.125 **
Connectivity	.123 **	.095 **	.116 **
Resolution	.065 **	.066 **	.077 **
Navigation Techniques	.053 **	.044 **	.053 **
Locus of Control	.007	.010	.013

** p (two tailed) < .001

Determinants of Interactivity

In this study, interactivity is not a direct question and is assumed to be a complex combination of the design requirements defined by Stuart (2001). In order to define the determinants of interactivity, a comment box is included in the questionnaire, which is not compulsory for respondents. Users were requested to identify the factors that will make this virtual environment more interactive. 942 respondents leave their comments willingly. User defined factors are subject to a frequency analysis and the results are given below.

Table 4: User Defined Determinants of Interactivity

19,8%	NPC Communication
19,3%	NPC Characteristics
19,1%	Storyline
13%	Artificial Intelligence
12,6%	Physics of the VE
9,6%	Object Design
9,1%	Small Scale Connectivity
7,7%	Nature Design
7%	World Design

6,4%	Guilds & Factions
5,7%	No Level Scaling
4,6%	Autonomy
4,3%	No Large Scale Connectivity
4,3%	Destructible Environments
4%	User Interface & Navigation Design
3,8%	3D Animations
3,7%	Large Scale Connectivity
3,2%	Companionship
3,2%	Combat Design
2,3%	Responsiveness
2,3%	Reputation
2%	World Economy

According to users, three most important factors for increasing interactivity are: NPC communication, NPC characteristics and storyline. NPC communication consists of facial expressions, non-verbal and verbal communication with the NPCs. These three user defined elements of communication are also components of the 'Rich Interaction Model' for virtual environments defined by Manninen (2003). According to user comments, designers should also implement more voice actors for the NPCs and avoid repetitive dialogue options. Given below is a gamer comment on voice acting, showing us the complexity of NPC communication.

"One of the most immersion-breaking parts of Oblivion was the terrible voice acting. Unlike Morrowind, many voice actors were re-used across races (Orcs and Nords, for instance), and voice actors that I came to strongly associate with certain races were reused improperly or not at all--for instance, the old Orc voice entirely disappeared, as far as I can hear, replaced very obviously with the Nord voice actor. Also, the performance given by the new voice actors was, I felt, not up to the level of that of the performances they gave for Morrowind. The delta between the old and new voices, both in usage and in quality of acting, was so extremely jarring--especially with the massively increased amount of voice in the game--that nearly every NPC to whom I talk breaks my immersion to some degree."

NPC characteristics primarily consists of depth and personality in non-player characters (NPCs). Synthetic characters must be responsive to their physical interactions with the environment, their aims, their knowledge of the virtual world, their personality and their interactions with human players (Magerko et al., 2004). According to player comments, designers should create NPCs from all ages and goal-driven non-player characters. Given below is one of the many gamer criticisms obtained by this study on character personality and autonomy in Oblivion:

"The key failing: Context sensitivity. NPCs, superficially, act in lifelike manners. However, they methods of reacting to the environments are limited to direct interaction with objects they are programmed to interact with; they sit on furniture, sleep in beds, eat food, and talk with other NPCs or the player. This seems realistic, until more exotic situations are presented; these behaviors are not changed whatsoever by

numerous factors that would impact the behavior of real people, such as weather, crime, etc. As an example, when nearby an open Oblivion gate, one would reasonably expect nearby people to be responding to it, possibly with emotions such as panic, fear, or perhaps even curiosity. The game's NPCs have no different reactions. Likewise, NPCs are not reactive to the events that take place around them; major game-related events, such as the completion of a quest, may alter what dialogue they have available, but their behavior is unaffected. As an example, if the player enters a busy city street, and one NPC suddenly attacks the player, the NPCs may respond to the attack by aiding the player, but after the battle has concluded, the NPC's behavior, and even dialogue, is not affected. This would appear to be a keystone in the elements of Artificial Intelligence that is lacking in the game of Oblivion, that would've added the realism level sufficient to truly make the NPCs seem as lifelike characters, rather than as flat 'simulation bots.'"

User defined components of storyline are meaningful play and user freedom of choice. Storyline is closely related to the description of plot given by Slater and Wilbur (1997) and freedom in the users' actions within a virtual environment is also highlighted by Mantovani & Riva (1999). According to Salen & Zimmerman (2004), user freedom of choice is an important requirement of game design and meaningful play is the relationship between player's actions and system outcome. Users also commented that they would like to see non-linear quests, consequences for their actions and moral choices in the gaming environment. Comments of gamers obtained by this study shed light on different dimensions of freedom. Given below is an example comment:

"I feel that in Oblivion's current form it offers much freedom of action (e.g. you may approach a problem as you wish, by using stealth magic or diplomacy) but not much freedom of morality and few consequences for moral choices. I would like Oblivion and games in general to make me care and understand how I alter the world and why I should be careful about my morality."

CONCLUSION

The extent of this paper is to indicate a number of variables that need to be considered in order to maximize presence in virtual environments, especially in computer games. This study does not claim to have identified all of the design requirements that affect presence but it addresses how certain requirements shall be addressed by designers. Research findings show that sociability has the highest correlation with presence. Computer games, regardless of their multiplayer capabilities, should be capable of creating social virtual environments. Since Heeter (1992) defined sociability as one of the three dimensions of presence, game designers should support social virtual characters that build communities and groups. Oblivion is a single player computer game and sociability primarily consists of PC-NPC interactions. Players commented that sociable non-player characters shall have entertaining and non-repetitive dialogue options, believable behaviors, and near-realistic 3D appearance and

animations. Players also indicated that guilds, NPC companions and character reputation are important social characteristics.

The virtual environment, with its physical appearance and object behaviors, should accurately represent the real world we are living in. Thus, veridicality is the consistency of information with the objective world and is one of the hypothesized realism factors that contribute to a sense of presence (Witmer & Singer, 1998). In this sense, players indicated that object design, world design, nature design and destructible environments are important characteristics of veridicality. According to Sutcliffe (2003), user interaction with the virtual world objects should conform to the laws of physics that constrain real-world interaction, yet players commented that real-world physics enhances the sense of presence experienced but without touch and force feedback, too much realism in world physics breaks the sense of presence.

Autonomy is the third best requirement correlating with presence. To sustain the feeling of presence in a virtual world, virtual agents should be able to make autonomous decisions independent of other entities in the environment and behave like real persons (Aylett & Luck, 2000). Designers should implement autonomy with caution, bearing in mind that autonomous characters are more life-like if their behaviors are consistent and sociable. Players commented that, NPCs of Oblivion who have a 24 hour schedule of their own, are less life-like than the NPCs who stand around in Morrowind: the predecessor of Oblivion.

Connectivity is the opportunity to share the virtual world together by connecting multiple computers via a network, usually either a LAN or the Internet. User defined interactivity requirements indicate an important difference in terms of connectivity. According to user comments, local area network (LAN) multiplayer capabilities and massive multiplayer capabilities are two different predictors of presence. Frequency analysis shows that, 4.3% does not want massive multiplayer capabilities, 3.7% wants massive multiplayer capabilities and 9.1% wants LAN multiplayer capabilities. This study used large scale connectivity as an independent variable but user comments indicated that large scale connectivity is not a good predictor of presence.

REFERENCES

- Aylett, R., & Luck, M. 2000. "Applying artificial intelligence to virtual reality: Intelligent virtual environments". *Applied Artificial Intelligence*, 14 (1), 3-32.
- Bostan, B. 2009. "Requirements Analysis of Presence: Insights from a RPG Game." *ACM Computers in Entertainment* 7, No.1 (March).
- Ermil, L., & Mäyrä, F. 2005. "Fundamental Components of the Gameplay Experience: Analysing Immersion". Paper presented at *DIGRA 2005: Changing Views: Worlds in Play*, Vancouver, Canada.
- Friedl, M. 2003. *Online game interactivity theory*. Hingham, MA : Charles River Media.
- Heeter, C. 1992. "Being there: The subjective experience of presence". *Presence: Teleoperators and Virtual Environments*, 1(2), 262-271.
- Heim, M. 1998. *Virtual Realism*. New York: Oxford.

- Held, R. & Durlach, N. 1992. "Telepresence". *Presence: Teleoperators and Virtual Environments*, 1(1), 109-112.
- Insko, B. E. 2003. "Measuring presence: Subjective, behavioral and physiological methods". In *Being There: Concepts, effects and measurement of user presence in synthetic environments*, Riva, G., Davide, F., & IJsselstein, W. A. (Eds.), Amsterdam: Ios Press.
- Laurel, B. 1993. *Computers as theatre*. Addison-Wesley Publishing Company, Reading, MA.
- Lessiter, J., Freeman, J., Keogh, E., & Davidoff, J. 2001. "A cross-media presence questionnaire: The ITC-Sense of presence inventory". *Presence: Teleoperators and Virtual Environments*, 10 (3), 282-297
- Lombard, M., & Ditton, T. 1997. "At the heart of it all: The concept of presence". *Journal of Computer Mediated Communication*, 3 (2).
- Magerko, B., Laird, J.E., Assanie, M., Kerfoot, A., & Stokes, D. 2004. "AI Characters and Directors for Interactive Computer Games". In *Proceedings of the 2004 Innovative Applications of Artificial Intelligence Conference*, San Jose, CA. AAAI Press.
- Manninen, T. 2003. "Interaction manifestations in multi-player games". In *Being There: Concepts, effects and measurement of user presence in synthetic environments*, Riva, G., Davide, F., & IJsselstein, W. A. (Eds.),. Amsterdam: Ios Press.
- Mantovani, G., & Riva, G. 1999. "Real presence: How different ontologies generate different criteria for presence, telepresence, and virtual presence". *Presence: Teleoperators & Virtual Environments*, 8 (5), 540- 550.
- Ondrejka, C. 2006. "Finding common ground in new worlds". *Games and Culture*, 1(1), 111-115.
- Rafaeli, S. 1988. "Interactivity: From new media to communication". In *Sage Annual Review of Communication Research: Advancing Communication Science*, R. P. Hawkins, J. M. Wiemann, & S. Pingree (Eds.), 16, 110-134. Beverly Hills: Sage.
- Regenbrecht, H., Schubert, T., & Friedmann, F. 1998. "Measuring the sense of presence and its relations to fear of heights in virtual environments". *International Journal of Human-Computer Interaction*, 10 (3), 233-249.
- Salen, K. & Zimmerman, E. 2003. *Rules of Play : Game Design Fundamentals*. Cambridge, MA: The MIT Press.
- Sheridan, T.B., 1992. "Musings on telepresence and virtual presence". *Presence: Teleoperators and Virtual Environments*, 1(1), 120-26.
- Slater, M. 1999. "Measuring presence: A response to Witmer and Singer questionnaire". *Presence: Teleoperators and Virtual Environments*, 8 (5), 560-566.
- Slater, M., & Wilbur, S. 1997. "A framework for immersive virtual environments (FIVE): Speculations on the role of presence in virtual environments". *Presence: Teleoperators and Virtual Environments*, 6 (6), 603-616.
- Steinkuehler, C. A. 2006. "Why Game (Culture) Studies Now?". *Games and Culture*, 1(1), 97-102.
- Stuart, R. 2001. *The design of virtual environments*. Ft. Lee, NJ: Barricade Boks.
- Sutcliffe, A. 2003. *Multimedia and virtual reality: Designing multisensory user interfaces*. Mahwah, NJ.: Lawrence Erlbaum Associates.
- Towell, J., & Towell, E. 1997. "Presence in text-based networked virtual environments or 'MUDS'". *Presence: Teleoperators and Virtual Environments*, 6 (5), 590-595.
- Witmer, B. G., & Singer, M. J. 1998. "Measuring presence in virtual environments: A presence questionnaire". *Presence: Teleoperators and Virtual Environments*, 7 (3), 225-240.
- Zahorik, P., & Jenison, R.L. 1998. "Presence as being-in-the-world". *Presence: Teleoperators and Virtual Environments*, 7 (1), 78-89.

AUTHOR BIOGRAPHIES

Barbaros BOSTAN is an Assistant Professor at Yeditepe University, Information Systems and Technologies Department. Bostan earned a BS at Electronics and Communication Engineering at Istanbul Technical University, an MBA from Yeditepe University, a Ph.D. degree at Informatics Department of Marmara University. Bostan has teaching experience in the areas of computer networks, virtual reality systems and interactive web technologies. His research areas include interactivity, presence, computer games, RPGs, virtual environments, multiplayer virtual worlds and interactive storytelling.

Sertac OGUT is an instructor and a designer. He teaches Visual Communication and Interaction Design courses at the Communications Faculty of Marmara University Istanbul/TURKEY. He earned his BA on Communicative Informatics at the Marmara University. Ogut completed his MA study at the Yeditepe University in Visual Communication Design. He had his PhD degree at the Informatics Department of Marmara University. Ogut focuses on Interaction Design, New Media Studies and 3D Animation. Besides his academic carrier, he is working on several web-based game projects as a consultant.