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The Third Pole of the Sense of Presence: Comparing Virtual and Imagery Spaces.

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ABSTRACT

As Biocca pointed out, the "two poles model" of presence has only considered the virtual and pyshical spaces, but not the imaginary spaces. This work is aimed at comparing the sense of presence between virtual and imaginary environments. 100 participants were randomly assigned to one of the two conditions (imagined versus virtual spaces) and the subjective sense of presence was measured in three moments (begining, middle, and end). Results indicate that the participants in "imagery" spaces indicated a decrease of their sense of presence, whereas the opposite occurs in participants in "virtual" spaces. Imagination seems not to be a long-lasting procedure to elicit presence. However, VR helps users to stay there as time goes by. That is, it provides a "physical" context in which the self can be placed.

Keywords: *presence, virtual reality, imagination, mental space.*

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1. Introduction

The sense of presence, the sense of "being there", is a psychological experience, determined by a complex variety of characteristics or components. In a simple way, it is usually defined as the subjective sense of being in a place. Many authors assume that a person feels present in an environment when his/her cognitive processes lead to a mental representation of a space, where the person locates himself / herself (Biocca, 1997; Schubert, Fridemann, & Regenbrecht, 2001). From this definition, it can be said that a person could feel presence in different kinds of spaces: real, imaginary, dreamed, "hallucinated", or virtual spaces. The recent possibility of creating virtual

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spaces has increased the interest for studying the sense of presence, but presence in non-real spaces was studied before virtual worlds were created. As Schubert and Crusius (2002) remind us, the phenomenon of presence has been researched in other domains, but with different labels, such as “diegetic effect” (in film theory), or “transportation” (in narrative theory and research). To review all of these contributions is beyond the scope of the present work. We are going to restrict it to the VR field.

In the VR field, research on presence has been dominated by what Biocca (2003) called “the two pole model”. Although the two poles model could be useful in the initial engineering research on remote operated telerobotcis or telepresence, it was erroneously generalized to all media and became a cognitive theory of presence (Biocca, 2003). This model has only taken into consideration two spaces: virtual and physical. Furthermore, it has over-emphasized the role that the “technological” variables, such as interactivity and immersion, play on the sense of presence. However, research is showing that although important, technology is not the only determinant of the sense of presence. Biocca (2002; 2003), Schubert, and Crusius (2002) have brought out into the open what is called “the book problem”, that is, the possibility of experiencing presence in a seemingly very low immersion, and the possibility of experiencing presence in a “non-perceived” space, but an imagined one.

Biocca (2003) has proposed “the three pole model of presence”. In this model, a third pole called “mental imagery space” is added. It is supposed that the processes involved in the presence in mental imagery space would be similar to those involved in physical or virtual spaces. In all cases, the experience of presence would be “mediated” by mentally constructing a simulation, a mental model of the space around the body. Virtual or imaginary, in either case, stimuli are only the raw material for the mind that constructs that mental representation of an environment. All physical, imaginary or virtual realities are a consequence of internal processing, they are not developed only from the immediate sensory information we receive (Schubert et al., 2001)

Biocca’s three-pole model offers a possible solution to “the book problem”. According to it, narratives achieve a level of presence by making use of the imagery space to “fill in” the spatial model cued by the book. Biocca suggests that spaces generated from mental imagery may not have as much sensory resolution, salience in memory and intersubjetive consistence as those generated from virtual spaces. The sense of

presence could be strong, but it may more difficult to generate and maintain the level of presence experience in virtual spaces. Also Schubert et al (2001) suggest that presence in imagined and virtual spaces could differ because virtual spaces offer a higher level of immersion and interaction, whereas imagination depends mainly on the cognition of the subject. So mentally representing the self in a space could be easier in virtual reality and harder in imagination. In fact, Freeman, Lessiter, Keogh, Bond and Chapman (2004) compared the sense of presence in a virtual relaxation island to only a relaxation narrative, and they have found differences indicating that presence was higher in the virtual environment. This study has only compared post-hoc measurement of presence.

The present work is addressed to test this assumption. We compare the sense of presence elicited from a perceptual / virtual environment with the presence elicited from an imagery environment in different moments through the experience. Following the above suggestions, presence in imagery spaces must be weaker than in virtual spaces.

2. Method

2.1 Experimental Design

A between-subjects design (factorial design) using repeated measures was used. A standard mood induction protocol (MIP) was used, in which we measured the subjective sense of presence in three moments during MIP (intra-subjects comparisons).

2.2 Participants

A hundred participants were recruited for the study from the Polytechnic University of Valencia, University of Valencia and University Jaume I of Castellon. There were 37 males, and 63 females. The mean age was 22.83 (SD = 3.90) with a range between 18 and 41. Participants were randomly allocated to one of the two experimental conditions (VR versus Imagery MIP). All participants fulfilled the following inclusion criteria: a) non history of neurological disease, head injury, learning disability or mental disorder; b) non history of psychological disorders; c) non use of any medication for psychological or emotional problem; and d) scoring lower than 18 in BDI (Beck Inventory Depression) (Beck et al.,1961).

2.3 Measures

UCL Presence Questionnaire (Slater, Usoh, & Steed, 1994): This is a post-test subjective presence measure composed by 3 items that assesses a users sense of presence by determining: a) Subject's sense of "being there" b) Extent to which the virtual environment becomes more "real or present" than everyday reality; and c) Extent to which the virtual environment is thought of as an actual place visited rather than seen. This questionnaire was adapted to ask about the imagery environment.

A variation of the first and the third questions of this measurement were selected to also be asked during the MIP (Presence: "Are you here, in this park?"; and Reality Judgment: "Do you feel this park is real, it is a place you are visiting?"). These two questions were implemented in the virtual and imagined environments in three different moments: a) Moment 1: at the beginning, one of the participants listens to an initial narrative that gives an introduction of the environment, and they are watching or imaging a first image of the park; b) Moment 2; in the middle of the experience, just after Velten task; c) "Moment 3": at the end, when the induction procedure is finished. Participants had to answer in a 0-10 scale.

2.4 Mood Induction Procedures (MIPs) Description

MIPs are experimental procedures whose aim is to provoke in an individual a transitory emotional state in a non-natural situation and in a controlled manner; the mood induced tries to be specific and pretends to be an experimental analogue of the mood that would happen in a certain natural situation (García-Palacios & Baños, 1999). MIPs include a broad diversity of methods and have proven to be efficient in achieving these changes in the target mood (for a review, see Gerrards-Hesse, Spies, & Hesse, 1994; Martin, 1990; Westermann, Spies, Stahl, & Hesse, 1996). The MIP designed for this work consists of a neutral environment that progressively changes depending on the mood state to be evoked on the user. The scenario was a park, and four variations were used, in order to evoke sadness, happiness, anxiety, and relaxation. In order to build the different environments, variations of every one of following elements were included: music, narratives, Velten self-statements [2] (Velten, 1968) plus picture (selected from International Affective Picture System IAPS, Lang, Bradley, & Cuthbert, 1995), movies, and autobiographical recalls. A previous study (Baños, Botella Guerrero, Liaño, Rey, & Alcañiz, 2004) has proved that this MIP is able to induce

[2] It is a MIP developed by Velten (1968), where mood induction is achieved by means of statements written in first person relative to the mood. Subjects are asked to read the statements, and to try to feel a mood similar to the one described in them.

different moods in users. Data from subjective mood state measurements showed that the four emotional environments (sadness, joy, anxiety, and relaxation) were able to produce mood changes in the users.

1) Description of the Virtual Reality MIP:

The MIP using VR was as follows: Users listened to a short history according to the emotional condition (sadness, happiness, anxiety and relaxation) ("Moment 1" in the assessment). A woman's voice guided users through the virtual walking. From the beginning, a piece of music was heard. The initial appearance of the environment was the same for all users. However, the aspect changed soon depending on the emotional condition (see Figures 1 and 2). Users had two minutes to freely explore the park. Then, they were asked to go to the center of the park, where a bandstand was. In five of the sides of the stand (it is an eight-faced polyhedron), a statement of the Velten (1968) technique appeared in a disordered manner and they had to order it. The content of the statements depended on the emotional condition. For each sentence, users had to choose a picture between four options, the one that best represented for them the meaning of the sentence. All pictures were selected from IAPS (Lang et al., 1995), in function of two criteria: they had to be "emotional" according to Lang et al. (1995) data and they had to be related with the content of the sentence. Users were asked to get involved in the contents of each sentence during 45 seconds, to think about the personal meaning of each statement ("Moment 2" in the assessment). After that, they could again walk around the virtual park during two more minutes. Then users were asked to go to the cinema to watch a short film. Once the cinema session was finished, users were asked to tell in a loud voice a personal recollection similar to the things that happened in the park ("Moment 3" in the assessment).

Fig. 1: The happy park.

Fig. 2: The sad park.

Regarding hardware, the hosts for virtual environments were hi-end computers with fast graphic cards and 128Mb of graphics memory and textures. The displays device was a metacrilate retro-projected screen of 400x150 cm. The retro-projection option allowed users to walk near the screen without blocking the image and projecting shadows on the screen. Resolution projectors were 1024x768 pixels and a power of 2000 lumens; however, it was regulated for a power of 1000 lumens in order to make users feel more comfortable. Regarding the interaction device, a joystick was used. This device was configured to have different modes of use, so by pressing a button it changed from navigation to interaction mode.

2) Description of the Imagery MIP:

In order to compare the levels of presence achieved in both virtual and imagery spaces, a traditional MIP was developed, using the same procedures (Velten sentences, movies, pictures, and music) without the mediation of the virtual environment, but imagination. The difference between VR-MIP and "imagery" MIP was that the first one uses a virtual environment where all elements are included, whereas the second one uses an imaginary environment where the same elements are included, that is, virtual parks were substituted by imagined parks, and all the rest elements and the procedure remained equal. The "imagery" MIP has been also developed to evoke four mood states: joy, sadness, anxiety and relaxation.

The procedure was as follows: Participants were alone in the laboratory. They listened to a tape-recording including all the instructions. First, they were asked to imagine a park that would leave them feeling sad, happy, anxious or relaxed. They were requested to generate a vivid image of the environment. Afterwards, participants listened to a narrative in function of the mood state that has to be induced ("Moment 1" in the assessment).. From the beginning, music was heard according to the mood state. Subjects were instructed to explore the imaginary park for 2 minutes freely. Then, they received instructions to go to the center of the imaginary park, where there was an imagery bandstand. In that moment, subjects had to read five Velten sentences written in a piece of paper (according to the mood state). In each piece of paper, for each of the sentences, they had to choose a photograph (selected from IAPS, Lang et al., 1995) between four options, the one that represented for them the content of that sentence (Pictures and sentences were printed on a notepad that participants got on the table). Participants had to get involved in the contents of each sentence during 45 seconds ("Moment 2" in the assessment). Then they were requested to again walk around the imaginary park during two more minutes. After that, subjects were asked to turn on a screen and to watch a part of a movie (selected to evoke some specific mood state). Finally, they were asked to tell in a loud voice a personal recollection similar to the things happening in the imaginary park ("Moment 2" in the assessment).

3. Results

For UCL post-test items, t-tests were carried out. Descriptive statistics and results are shown in Table 1. Statistical analysis revealed that VR group scored higher on realism than "imagery" group.

	VR	IMAGERY	Group differences
Sense of being there	4,68 (1,51)	4,83 (1,26)	N.S.
Realism	4,48 (1,63)	3,55 (1,50)	*t=2,89, d.f.= 18 p < .057*
Visited somewhere	4,77 (1,47)	4,22 (1,90)	N.S.

Table 1: Mean and (standard deviation) ratings from "UCL questionnaire.

Furthermore, the two questions about presence and reality judgment during the induction were analyzed. Descriptive statistics are shown in Figures 3 and 4. The only significant effects were the moment x condition interactions for both questions (Presence: F (2, 91) = 22,564, p< ,000; Reality Judgment: F (2, 91) = 22,217, p< ,000). That is, whereas "VR" group shows an increase on the "sense of being there" and "reality attribution", "Imagery" group shows the opposite pattern.

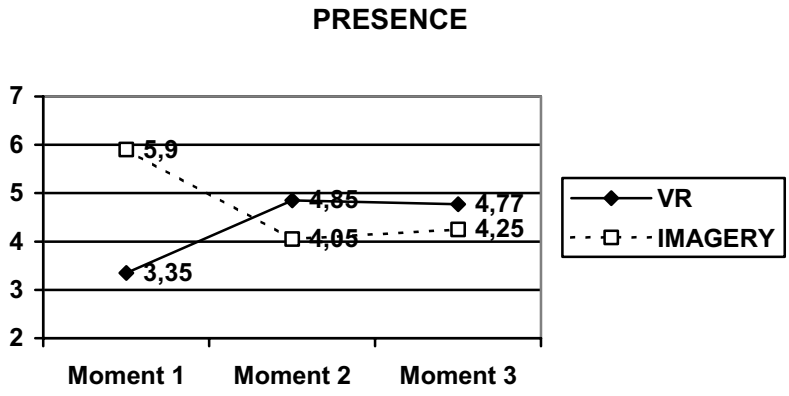

Fig. 3: Presence scores during MIP.

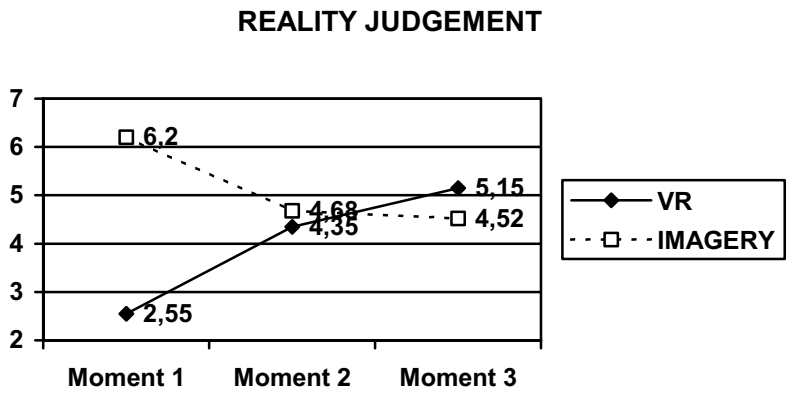

Fig. 4: Reality judgment scores during MIP.

4. Discussion

Results of this study show that there are differences between subjective sense of presence in virtual environments and imagery environments. Data indicate that participants in the imagery space informed a high sense of presence at the beginning, but a decrease was observed and at the end they informed a low sense of presence. However, participants in the virtual space showed the opposite pattern: their subjective sense of presence was increasing through the virtual experience. It seems that the imagination is a good procedure to elicit sense of presence, but users have some difficulties in maintaining it in an imaginary space. It could be difficult for people to suppress for a long time the actual physical environment (laboratory) in favour of an alternative and cognitive environment. However, VR system helps the user to "stay there" as time goes by. That is, it provides the person a "real physical" context in which him/herself can be placed, instead of the actual environment.

Some limitations of this study have to be mentioned. Firstly, the narrative to which participants listened was mainly focused on emotions and feelings. Some spatial cues were offered, but individuals were aimed to mentally construct the space by themselves. However, Gysbers, Klimmt, Hartmann, Nosper and Vorderer (2004) manipulated two elements of message to facilitate spatial presence during reading: the number of spatial descriptions (cues) in the text and the integration of explicit instructions to imagine the described spatial environment as vividly as possible. Contrary to their initial hypothesis, data indicated that the spatial presence scores were highest in the condition of few spatial cues and no imagination instructions, and "suspension of disbelief" was also most intense in this experimental condition. The authors suggested that detailed spatial descriptions and imagination instructions in the text could limit readers' imagination and fantasy regarding their 'active illusion' to be located in the space. According to the authors, the high "suspension of disbelief" value in the "low spatial cues and no instruction" condition supports this interpretation, because it points at more active imagination processes in the readers of this experimental group. Along with this study, readers will more likely succeed in imagining self-location in the text's world if the text leaves the specific spatial configuration of the portrayed environment open to the individual reader's spatial imagination.

The main shortcoming of this study is the lack of consideration of individual differences in mental imagery ability. So it will be needed to study the role of individual imagery skills on the sense of presence in imagery spaces. However, Freeman et al. (2004) have found correlations between mental imagery ability and induced relaxation

(only in the narrative condition, not in the virtual condition), but they have not found relationships between mental imagery ability and presence.

Despite limitations, results of this study suggest that it is easier to feel presence and to maintain this feeling when the representation of the space comes from "perceptual/outside" stimuli, at least for individuals in a normal state of consciousness. This finding is also relevant from an applied perspective. One of the more promising VR applications is psychological treatment. Virtual exposure to the feared environments has shown to be an efficient tool in the treatment of phobias. Results of the present study point out that "virtual exposure" could be more efficient than "imagery exposure" because it could elicit a higher sense of presence. Exposure techniques are usually applied during long sessions (30-45 minutes usually), and it is needed that patients feel the feared environment as real, and that they locate themselves in it. So, when long sessions are used, it could be easier for people to maintain their selves located in a "perceptual" (virtual) space rather than an imagery space.

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