More Breaks Less Presence

Andrea Brogni, Mel Slater and Anthony Steed
Department of Computer Science,
University College London,
UK
www.cs.ucl.ac.uk/research/vr

1. Introduction

The concept of 'breaks in presence' (BIPs) was introduced in Slater and Steed (2000). The idea was that rather than only use a post-experience questionnaire to assess presence, it could be assessed during the experience itself. The hypothesis was that during immersion in a VE a participant simultaneously perceives two streams of sensory data – from the real world, and also from the virtual world. At any one moment these sense impressions would be the basis of a perceptual Gestalt, corresponding more or less to the world portrayed by the VE or to the real world in which the whole event was taking place. Sensory data corresponding to the non-favoured interpretation may be ignored, or *incorporated* into the prevailing Gestalt. For example, a Cave wall may not be noticed, a loud sound that does not belong to the virtual world may be incorporated into the flow of events within the virtual world interpretation, and so on. This is much like what happens in dreams, where sensory data from the physical world (a sound, a flashing light, something touching the sleeper's face) are incorporated into the ongoing dream – in an attempt to keep the dream going for as long as possible. However, occasionally, as in dreams, the participant experiences a Gestalt switch from the virtual to the real interpretation. A 'break in presence' is any event whereby, for the participant, at that moment, the real world becomes apparent, and for the duration of that event, the participant acts and responds more to the real world setting than to the virtual world.

This model is an abstraction – and like any abstraction it does not deal with the full complexity of reality. For example, it does not account for mixed perceptions where the participant simultaneously holds and even partially responds to both (real and virtual) interpretations, as noted by Spagnolli & Gamberini (2002).

In the original Slater & Steed (2000) paper a Markov Chain was used to model the sequence of transitions from virtual to real, and transition probabilities were derived. BIPs were signalled by participants in an experiment by a verbal signal whenever one happened. This followed a period of training at the start of the experiment. It was argued that asking subjects to report BIPs in this way would not in itself disrupt presence, because BIPs were only reported after presence in the VE had already been disrupted. It was noted that the training itself could bias people to report BIPs, but that this bias was uniform across the sample, and should not influence relationships between statistical measures based on BIPs and other variables.

In this paper we concentrate on the relationship between BIPs and reported questionnaire based 'presence'. Rather than use the more complex measure based on the Markov Chain analysis, we simply count the number of BIPs reported by subjects. Our hypothesis is that the greater the number of BIPs the lower the reported overall presence should be, on the average.

In Section 2 we outline the experiment, with results in Section 3, and the conclusions in Section 4. The experiment was conducted for many reasons and to test several different hypotheses unrelated to the main issue of this paper. We only provide information that is sufficient for the purposes of this paper.

2. Experimental Design

The main aim of the experiment was to examine the variation of reported presence in six different virtual urban environments. The worlds were chosen with different characteristics in terms of space, surface modelling, and the existence and behaviour of avatars. In this paper we report only the result of the participants' reporting of BIPs during the experience and reported presence after the event via the questionnaire results, and we concentrate on the relationship between these.

Sixty volunteers were distributed randomly and equally into the different worlds and were gender balanced. The participants were placed inside a Cave-like system (Cruz-Neira et al., 1993) and were asked to visit the urban virtual environment through which they were able to move around freely using a Wand. The system was a Trimension Reactor with 4 walls, and with Intersense Tracking. There was no interaction with the objects of the virtual environment.

Before the experiment, the subjects answered a web-based questionnaire containing a series of general demographic questions. They were then trained in the recognition of the breaks in presence (BIPs) through the visualization of eight 2D images having Gestalt properties (Kohler, 1947). It was explained that during the VE exposure the subject might experience transitions in the sense of place just in the same way as they perceived Gestalt transition between foreground and background in the 2D images, but this time between the laboratory and the virtual environment. After that, the volunteers were told to signal, pressing on any button on the wand, only when the laboratory becomes more dominant than the virtual environment. Subjects were also advised to inform the experimenter at any time if the instructions were not clear.

The virtual experience lasted between four and five minutes for each participant. The laboratory lights were dimmed and all possible noise reduced to the minimum, to reduce the chance of BIPs that could have been due to the laboratory. After four minutes of virtual experience the subjects were advised verbally that the experience was about to halt, the lights in the lab were restored to full brightness and the simulation and any other recording stopped. After the experience a post-experience questionnaire and a post-training questionnaire were administered.

During the virtual experience, any time the button on the wand device was pressed the elapsed time since the beginning of the experiment was recorded. In addition the subject completed a web-based questionnaire after the virtual experience. These included the following questions on a 1 to 7 scale, where 7 always means higher reported presence. The questions were related to the sense of being in the laboratory or the VE, the awareness of the lab or the VE, which one was more real the lab or VE, the feeling being similar to having seen a movie or visited a real place:

- *During the course of the experience, I had a sense of being ...* (1. mostly in the 'laboratory' … 7. mostly in the 'virtual environment');
- *During the course of the experience, I was aware mostly of ...* (1. the 'laboratory' … 7. the 'virtual environment');
- *During the course of the experience, which environment was more real?* (1. the 'laboratory' … 7. the 'virtual environment');
- *During the course of the experience, I felt that the 'virtual environment' was something ...* (1. I saw (as in a movie) … 7. I visited (some how similar to walking in a real environment)).

The overall reported presence variable was the count of the number of answers that had a score of 6 or 7 (following, e.g., Slater & Steed, 2002).

3. Results

Under the null hypothesis that BIPs occur at random, unrelated to anything else, they should be distributed in time according to a Poisson process. Therefore the response variable here, number of BIPs, can be treated as a Poisson random variable, and log-linear regression should be used (Dupont, 2002). The goodness of fit for a log-linear analysis is the change in deviance caused by adding or deleting terms from the model. This has an approximate Chi-Squared distribution with degrees of freedom equal to the change in number of parameters.

A number of 'consistency check' questions were included in the post-experience questionnaire. We would expect each of these to have a significant association with the number of BIPs. We consider each one in turn:

- *During the course of the experience, how alone did you feel?* (1. not at all alone … 7. extremely alone).

Feeling alone – This is significantly and positively related with the number of BIPs (change in deviance = 9.1 on 1 d.f., P = 0.0026).

- *During the course of the experience, I felt as if there was nobody watching me.* (1. strongly disagree … 7. strongly agree).

Feeling that no one is watching me - is significantly and negatively related (meaning that more BIPs are associated with more of a sense of being watched) (change in deviance = 6.6 on 1 d.f., P = 0.01).

- *During the course of the experience, how much were you aware of the background sounds of the 'laboratory'?* (1. not at all aware … 7. extremely aware).

Aware of the sounds in the lab - is significantly and positively associated with the number of BIPs, meaning that the more the person was aware of sounds in the outside laboratory the greater the number of BIPs (change in deviance = 24.53 on 1 d.f., P ≈ 0).

- *During the course of the experience, how much were you aware of the experimenter ?* (not at all aware … extremely aware).

Aware of the experimenter - being aware of the experimenter is not significantly related associated with the number of BIPs.

The most important co-variate is the presence count itself. If we consider a regression of the number of BIPs on the presence score then it is highly significant (change in deviance = 32.78 on 1 d.f., P ≈ 0). The reported presence variable is negatively correlated with the number of BIPs. There is, therefore, a highly significant relationship between the number of BIPs collected during the experience and the presence questions administered after the experience, two variables which in terms of the way they are constructed, should, in principle from a purely procedural point of view, be independent.

4. Conclusions

The aim of this paper was to report a further result on the relationship between questionnaire-based presence and the number of BIPs during the course of a VE experience. The results we have obtained are encouraging for further experiments, because the reported presence seems to be negatively correlated with the number of BIPs. The latter are reported during the experience, and not based on an after-the-event questionnaire, so, are more likely to be an on-line reading of the level of presence, which can give us information not only about the complete experience, but also about the single events during the experience. The methodology of recording BIPs is not

satisfactory, relying on subjective reporting, and also has the problem of potentially producing a bias due to the training as mentioned earlier. Our current research is addressing these problems.

Acknowledgements

This research is funded by the UK EPSRC Equator project and PRESENCIA (IST-2001-37927). We thank Daniela Romano and Joel Jordan for their help. Finally, we would like to thank all the participants.

References

Cruz-Neira, C., Sandin, D. & DeFanti, T. (1993) Surround-screen projection-based virtual reality: The design and implementation of the CAVE, Proceedings of SIGGRAPH'93, pages 135–142. ACM – SIGGRAPH.

Dupont, W.D. (2002) Statistical modelling for biomedical researchers: a simple introduction to the analysis of complex data. Cambridge University Press.

Kohler, W. (1947) Gestalt Psychology: An Introduction to New Concepts in Modern Psychology. Liveright Publ. Corp., New York.

Slater, M. & Steed, A.J. (200) A virtual presence counter, Presence: Teleoperators and Virtual Environments, 9(5):413–434.

Spagnolli, A., & Gamberini, L. (2002) Immersion/Emersion: Presence in hybrid environments. Paper presented at the Presence 2002: Fifth Annual International Workshop, Porto, Portugal, 9-11 October 2002.

Usoh, M, Catena, E., Arman, S. & Slater, M. (2000) Using presence questionnaires in reality, Presence: Teleoperators and Virtual Environments, 9(5): 497–503.