

The Illusion of Being Present:

Using the Interactive Tent to Create Immersive Experiences

Eva and John Waterworth, Johanna Holmgren, Tomas Rimbark and Rita Lauria^Φ

eva.lindh.waterworth@interactiveinstitute.se

Phone +46 90 185136, Fax +46 90 185137

Interactive Institute
Tools for Creativity Studio
Tvistevägen 47, Box 7964,
SE-907 19 Umeå
Sweden

Dept of Informatics
Umeå University
Umeå
SE-901 87
Sweden

^ΦMIND Labs
1507 Military Cutoff Road, Ste.
214,
Wilmington
North Carolina
USA

Abstract

We describe a novel immersive environment – the Interactive Tent – and an artistic production within it – The Illusion of Being. In this production, immersants experience a vivid cycle of the seasons in a way that depends on their bodily movements. Everybody's experience of The Illusion is unique, since by moving immersants slip from one version of the seasonal cycle to another. In all, there are four versions, created to have differential effects on sense of presence and of time's passage, according to a theoretical model. An experiment, conducted to assess the effects of the different content versions, is reported. The results confirmed the model's prediction that rated presence is relatively high when the content elicits predominantly concrete (perceptual) processing, and relatively low when the emphasis is on more abstract (conceptual) processing. But the concrete-abstract dimension had no direct effect on judged duration, contrary to our predictions. However, there was some evidence that judged presence and estimated duration were positively correlated for content categorised as real, but there was no evidence of a correlation for content categorised as virtual.

Keywords: creativity, subjective duration, abstract, concrete, streams of consciousness

1 Introduction: Virtuality and the Three Dimensions of Experience

The main motivation for our work at the Tools for Creativity Studio is the insight that current uses of information technology - in working and everyday life – often reduce the cognitive space in which people can be creative. Our main aim is to redress this situation by developing virtual and mixed-reality *Creative Spaces*, in which novel ideas can be generated, manipulated, examined, stored, recalled, and reflected upon.

We take a modular, process-based approach to supporting personal creativity in a variety of settings, including the normal working office environment. It is founded on the idea that information technology can be used to provide tools for creativity, if we take seriously both individual psychological and social aspects of the processes of creative idea generation and innovation. One of the developments in IT that makes this possible is the move towards the concretisation of information, through multimedia and multimodal systems including virtual realities. These technologies permit a more embodied, physical, and less abstract, style of

interaction with information presented in apparently concrete forms, as compared to earlier technologies requiring essentially abstract and linguistic forms of interaction.

Virtual and mixed reality environments can produce vivid experiences and generate powerful emotions. Within the overall aim of supporting creativity, we are experimenting – both artistically and scientifically – with the factors that determine the nature of subjective experiences within such environments. Sense of presence and the subjective experience of duration are of particular interest. Our current approach is based on a three-dimensional model of experience, comprised of *locus*, *focus* and *sensus* (Waterworth and Waterworth, 2001).

Locus captures the extent to which the observer is focused on the real world or a virtual model. Focus describes the nature of the user's attention, specifically whether they are attending to currently present stimuli (from the real or virtual world) – in which case they will experience a feeling of *presence* – or are attending to information which is not currently present in the real or virtual environment. The former can be characterised as perceptual (or concrete) processing, the latter as conceptual (or abstract) processing. We refer to this latter, reflective state of mind as *absence*. Finally, the sensus dimension refers to the level of attentional arousal of the observer, and ranges from awake and alert to asleep and totally unconscious (see Figure 1). Refer to Waterworth and Waterworth (2001) for more details of the model and its application.

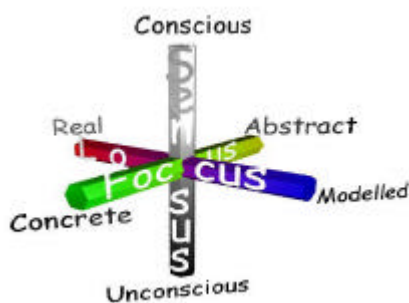


Figure 1 – The 3 Dimensions of Virtual Experience

2 The Interactive Tent and the Illusion of Being

In a tent we are secluded but also in touch, with nature and with ourselves. An ordinary tent can provide a meditative, relaxing environment, but also an aesthetically or intellectually stimulating one. We can refresh ourselves and explore new thoughts. A tent can be a very personal, unthreatening and emotionally-engaging place. These characteristics guided our choice of using a tent-like structure as one environment in which to implement creative spaces.

The Interactive Tent (Figure 2) is an environment within which several of the stages of our hypothesised creative process can be realised. It is also a test-bed for experimenting with the nature and possibilities of experience in virtual environments. The tent has a simple and inexpensive material structure - rather like a normal tent. Video images are projected onto the outside of the tent, which is constructed from back projection material, and viewed from inside as an enveloping visual display. There is also a 3D sound system and an inlet for smells.

We can also manipulate, and/or allow the occupant to control, the nature of displays: to stimulate presence or absence (focus), and vary the degree of realism - effectively moving the occupant along the real-modelled dimension (locus). Exactly how the occupant interacts with the tent is also of great importance – this can be more or less conscious and deliberate. For example, if we use depth of breathing or general posture to control the display in some

particular way, this has quite a different effect on the level of consciousness needed to interact than if we use arm gestures or spoken commands (in other words, these vary on the sensus dimension). The effect of varying the means of interaction is a main focus of our ongoing research.

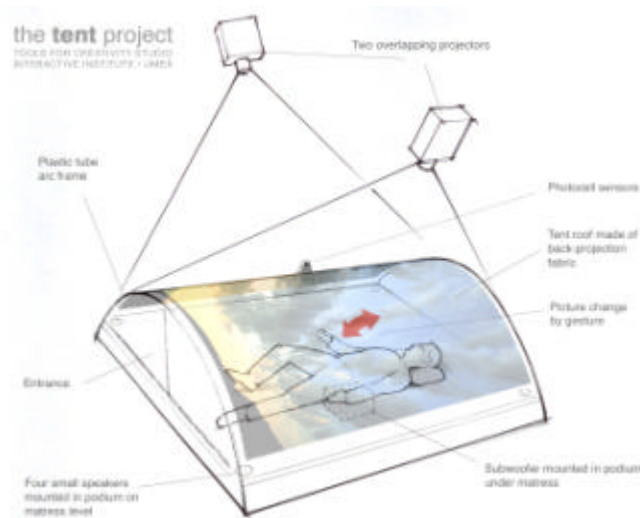


Figure 2 – the Interactive Tent

The Illusion of Being is a production for the tent, designed to allow participants to experience the three-dimensional model of experience outlined earlier, in a vivid and moving way – a way that is both experientially poignant and thought provoking. We do this by transporting the tent occupant between states of excitement and calmness, and between modes of presentation which elicit thought or direct sensory experiences.

In the *Illusion of Being*, the tent occupant is carried through a relentless cycle of four “elements”: snow, fire, earth, and water, as shown in Figure 3. The light (snow) – dark (earth) opposition symbolises the poles of the sensus dimension of conscious-unconscious. Both extremes of white (pure consciousness) and black (pure unconsciousness) are silent and still, whereas the other poles, fire and water, are both extremely noisy and visually lively.



Figure 3 – Cycle of Elements in *The Illusion of Being*

The other two dimensions are exercised dynamically through the behaviour of the tent occupant. In its current implementation, we use pressure and motion sensors to detect head position and degree of body movement. Moving the head up or down determines whether the

elemental cycle is experienced in a concrete, perceptual way or in a more abstract version requiring conceptual processing. Moving the head to the left or right determines whether what is experienced is captured from reality or is entirely synthetic (see Figure 4).

To make this possible, we have produced four versions of the elemental “story”, which run in synchrony and continuously, although the occupant experiences only one at any one time. A shift in head position causes the presentation to change to the appropriate parallel track – real/concrete, real/abstract, virtual/concrete or virtual/abstract, which are characterised as follows:

1. Real/Concrete – filmed events with natural soundtrack (**Camera** film)
2. Real/Abstract – text, sketches and spoken words describing events (**Words** film)
3. Virtual/Concrete – detailed virtual reality version, with synthesised sound effects (**3D** film)
4. Virtual/Abstract – wireframe 3D with text labels and stylised synthetic sound effects (**Wire** film)

These four tracks are designed to instantiate alternative ways of being – different ways of experiencing the same underlying reality of the relentless cycle of the elements – as characterised by the focus and locus dimensions of experience. We want participants to feel present or engage in reflective thought, to merely relax or be highly alert, depending on the stream they are sampling. Changes in the occupant’s bodily attitude determine which stream is experienced at any given time.

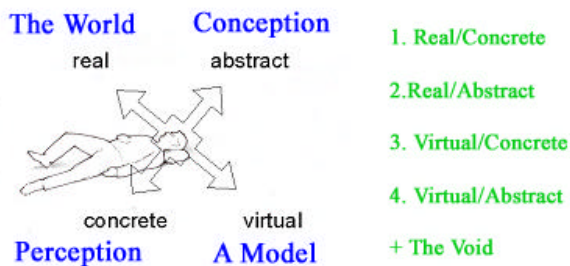


Figure 4 – Four Streams of Consciousness in *The Illusion of Being*

Exhibitions of *the Illusion of Being* suggest that it meets the goal of providing an emotionally compelling and thought provoking experience. An interesting outcome has been that several tent occupants report psychological changes depending on which “stream of consciousness” they follow

The Illusion of Being exemplifies one aspect of our research approach, whereby we test theoretical formulations, about performance or experiences in an innovative interactive environment, by creating an artistic production around the prediction of the theory. If the production is a success in artistic terms, we take this as partial validation of the theoretical and implementational approach taken. The other, more scientific, aspect of our research approach is exemplified below, where we test the effect of the content used for *The Illusion* in a more controlled way.

3 Presence and Subjective Duration: An Experimental Study

Waterworth and Waterworth (2001) suggest that the current load of abstract processing affects both the experience of duration and the sense of presence. This means that an experience which has a high level of presence and therefore requires little abstract thinking, should be experienced as having a longer duration than an experience which has a low level of presence and requires a lot of abstract thinking. The experiment to be described was

designed to test these claims, using the tent as an immersive environment, and the four streams produced for the Illusion of Being as test materials.

The relation between presence and experienced duration is a contentious issue. Different researchers disagree on how presence affects the subjective experience of duration. Several researchers have suggested, contra our model, that when the subjective duration of an experience was short, then the degree of presence would be high (Ijsselstein et al., 2001; Lombard, 2000).

We tested the question of whether or not the relation between presence and the experience of duration does in fact exist. And if it does, is it as described by Waterworth and Waterworth (2001) or the opposite of that? These are important questions, not least because if subjective duration indicates level of presence, it could be a useful way of measuring presence. We chose to assess presence in the experiment with a subjective method, a simple questionnaire (see below), and obtained verbal estimates (in minutes and seconds) of experienced duration.

The experiment was conducted with volunteers in the Tent, and using the four different “films” produced for the Illusion of Being, as described in Section 2 above. Two of the films were designed to elicit concrete processing and two were designed to elicit abstract processing. One of each of these pairs of films contained what could be described as real content, while the other contained virtual or modelled content, as described in Section 2 and illustrated in Figure 4.

3.1 Respondents and Instructions

16 people were selected for the experiment. The respondents were all students at Umeå University, who had volunteered for the experiment. Most of them had done this by answering a mail that was sent to all students at the Department of Informatics. All the respondents were between 20 and 40 years old, and all except one were male. This was not our choice, but simply reflects the people who selected themselves by responding to our request.

The respondents were informed that they would be shown four sets of four film clips inside the Tent and that they would be asked to estimate the duration immediately after each film clip. However, they were also asked to try to concentrate on what they experienced inside the Tent during the film clips, and not make too much of an effort of keeping track of the elapsed time. We chose to let the subjects receive this information in advance, because it would have been impossible to keep them naïve to the purpose of the experiment while asking them the same question 16 times. By telling them to try not to concentrate on the elapsed time, but on what they experienced, we believe we got the participants to focus more on the films, and to do this more evenly throughout the experiment, than they otherwise might have done.

Every respondent got the same treatment. We tried to talk as little as possible with the subjects before and during the experiment, and all instructions were read from a manuscript, to avoid giving the respondents information that could have biased our results.

3.2 Materials, Measures and Procedure

There were four different durations of the film clips (23 sec, 50 sec, 77 sec and 104 sec). For every respondent, each duration was used exactly four times. The durations were mixed in a way that made it difficult for the respondents to recognize the duration of one clip to be the same as another. Immediately after each film clip, the respondents were asked to estimate the duration of the film clip. The estimated duration was then compared to the actual duration of the clip.

After each film (four film clips), the respondent was brought out of the Tent to fill in a questionnaire, which was used to measure the presence experienced during the film. For this we used eight questions from the Igroup Presence Questionnaire (IPQ) of Schubert et al. (in press), as shown in appendix 1. The IP questionnaire was chosen because we feel the questions cover the experience of presence in a wide sense, and also because it takes the respondents' attention to the surroundings into account. The original IPQ consists of 14 questions, but we chose to disregard some of them. One of the questions was removed because it presupposes the respondent being able to control the virtual world, which they were not in our experiment. The other five were removed because they were too similar to other questions in the questionnaire, and we believe that having too many similar questions might have confused the respondents or made them tired. Also, one of the remaining questions needed some modification in order to fit into our experiment. This question also presupposes that the respondent is able to somehow control the virtual environment, but since the question was otherwise relevant to our experiment we felt that it was better to modify it than to disregard it altogether.

The questionnaire was presented in English. We had the possibility to translate the questions into Swedish, but we felt that we did not have the knowledge needed to do this without risk of losing the true meaning of the questions. In order to make sure that as little as possible of the questionnaire was misunderstood due to language difficulties however, the words we believed could be difficult to understand were translated into Swedish. All our participants were reasonably fluent in English.

3.3 Expected results

As mentioned earlier, two of the films used in the experiment were created to be concrete and the other two to be abstract. The respondents were expected to experience presence differently depending on if the film they were watching was concrete or abstract. Our hypothesis was that the concrete films (Camera and 3D) would cause the respondents to feel more present than they would while watching the abstract films (Wire and Words), since they would focus more on the things they perceived and would do less abstract thinking.

In addition to the varied sense of presence, we expected the general perception of duration to differ between the films, since subjective duration can be affected by "*...the amount of conceptual processing performed during an interval, relative to the level at which an individual habitually performs*". Waterworth and Waterworth, (2001, page 4). While watching the abstract films, which are more likely to require a lot of abstract thinking, we predicted that the respondents would feel that time passed more quickly than with the concrete films in which most of the focus is on the things perceived.

4 Results from the Experiment

4.1 Films and Presence

We found a highly significant effect of film identity on rated presence. This is in accordance with our predictions before we started the experiment. The average presence ratings for the 3D and Camera films were significantly higher than the ratings for the two abstract films. The concrete Camera film gave the highest presence, with the 3D film just beneath it. The Wire film gave a rather low presence rating, much lower than the two concrete films, but had a higher presence rating than the Words film, which was the one with the lowest presence rating of them all. This means that the respondents in general felt much less present while experiencing the abstract films (see figure 5).

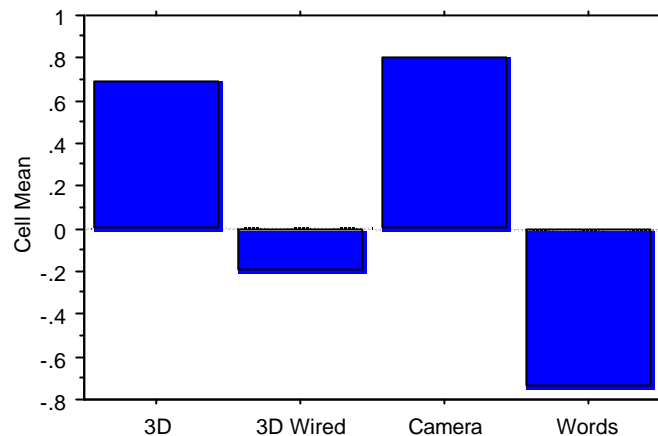


Figure 5 - Sense of presence (mean values for each film)

This is in accordance with the view that degree of experienced presence is a reflection of the competition in consciousness between concrete and abstract processing (Waterworth and Waterworth, 2001). When a lot of abstract processing is performed, concrete processing is reduced and when a lot of concrete processing is performed, abstract processing cannot continue with the same intensity. When the subjects did a lot of abstract thinking they tended to experience less presence, and when they did less abstract thinking they experienced a higher level of presence (see figure 6).

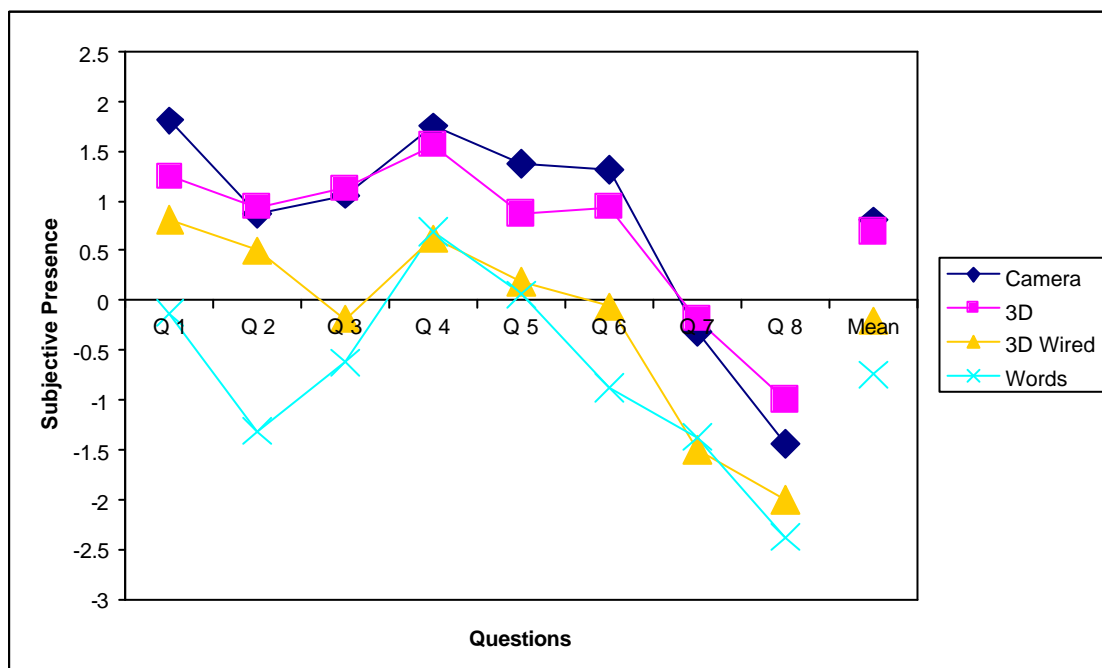


Figure 6 – Rated Sense of Presence (mean values for each question)

The values were calculated by taking the individual presence ratings (a number between -3 and +3) and then calculating the mean value for each question for each film.

4.3 Films and duration

The effect the films had on estimated duration is shown in figure 7.

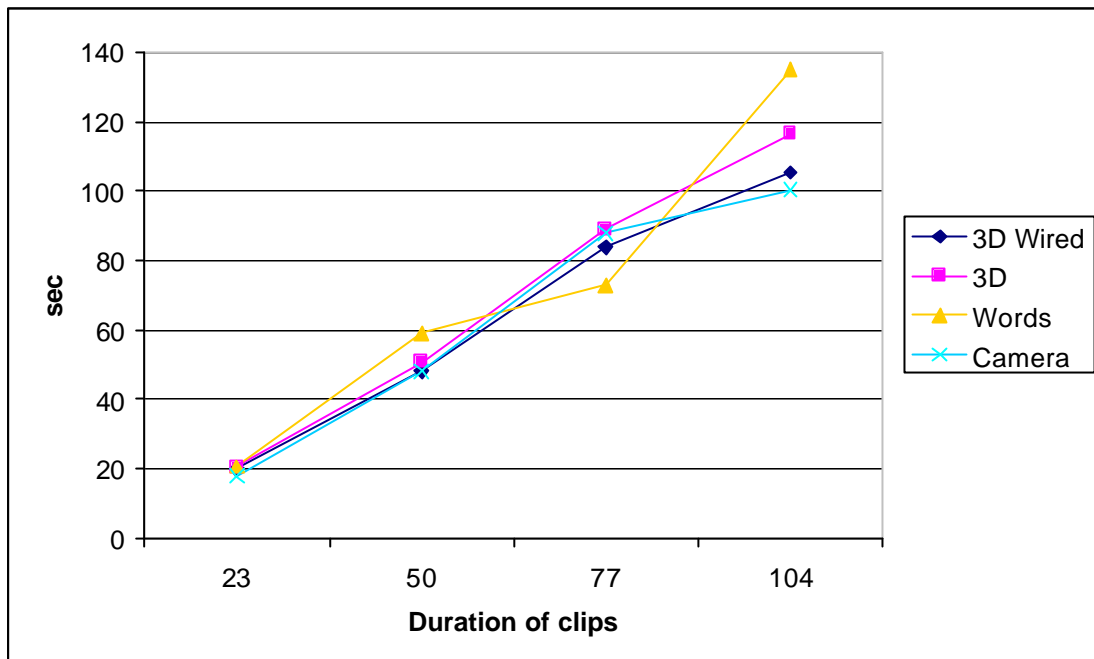


Figure 7 - Subjective duration as a function of clock duration, for each of the films

This chart shows that the Words film had a slightly different curve than the other films, which all follow almost the same pattern. However, as it turned out, this difference proved not to be statistically significant, and therefore, no conclusions can be drawn from this.

Since there was no effect of film identity on estimated duration, this suggests that the abstraction level of a film does not affect the estimated duration in the way we predicted in our expected results section, at least in the experimental situation – where respondents were merely observing the materials presented.

4.4 Rated Presence and Estimated Duration

We compared each respondent's perception of duration with his or her individual presence ratings. We had predicted that an individual who experienced a high level of presence would also tend to give a long estimation of duration. Figures 6 and 7 show the plots for the two virtual films, Wire and 3D.

The plot in figure 6 shows a significant positive correlation for the film Wire, which was the abstract/virtual film. The higher the presence an individual experienced while viewing this film, the longer the duration estimate. There is also a positive correlation shown in the plot in figure 7, the concrete/virtual film 3D, but here the relationship was weaker and only approached statistical significance.

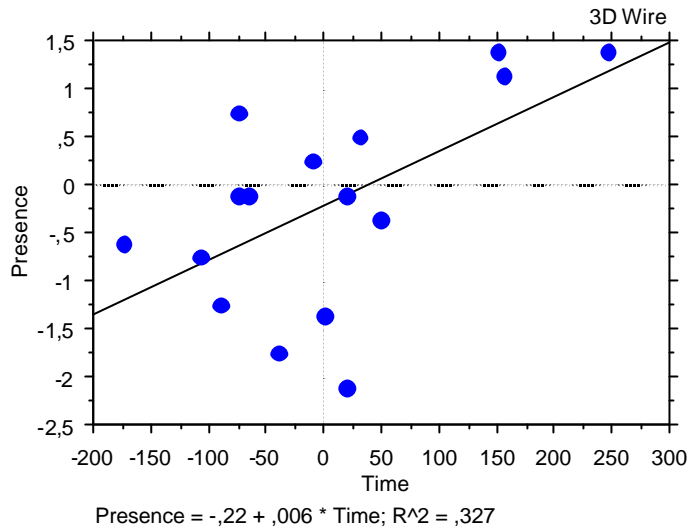


Figure 6; Bivariate scattergram for film Wire, including regression.

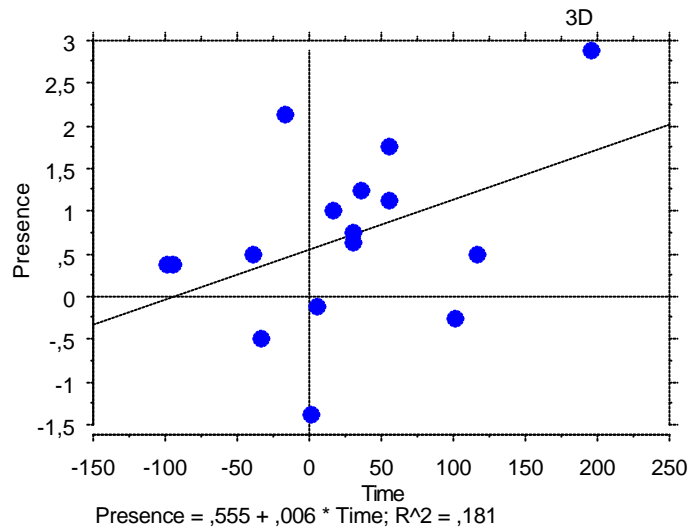


Figure 7; Bivariate scattergram for film 3D, including regression.

With the two other films, the abstract/real Words film and the concrete/real Camera film, there was no evidence of any correlation between rated presence and judged duration.

Although the evidence is not strong, given the non-effect of content on judged duration, the pattern of correlations reported above suggests that the real-virtual (locus) dimension may have an effect on the relationship between rated presence and estimated duration. Specifically, these two factors tend to be positively correlated for virtual content, but unrelated with real content.

Figure 8 shows each respondent's overall presence rating, and it can be seen that there were great individual differences in experienced presence. For example, while the fourth respondent experienced a very strong sense of presence, the 12th respondent experienced very little presence overall, despite the fact that both of them had seen exactly the same film clips.

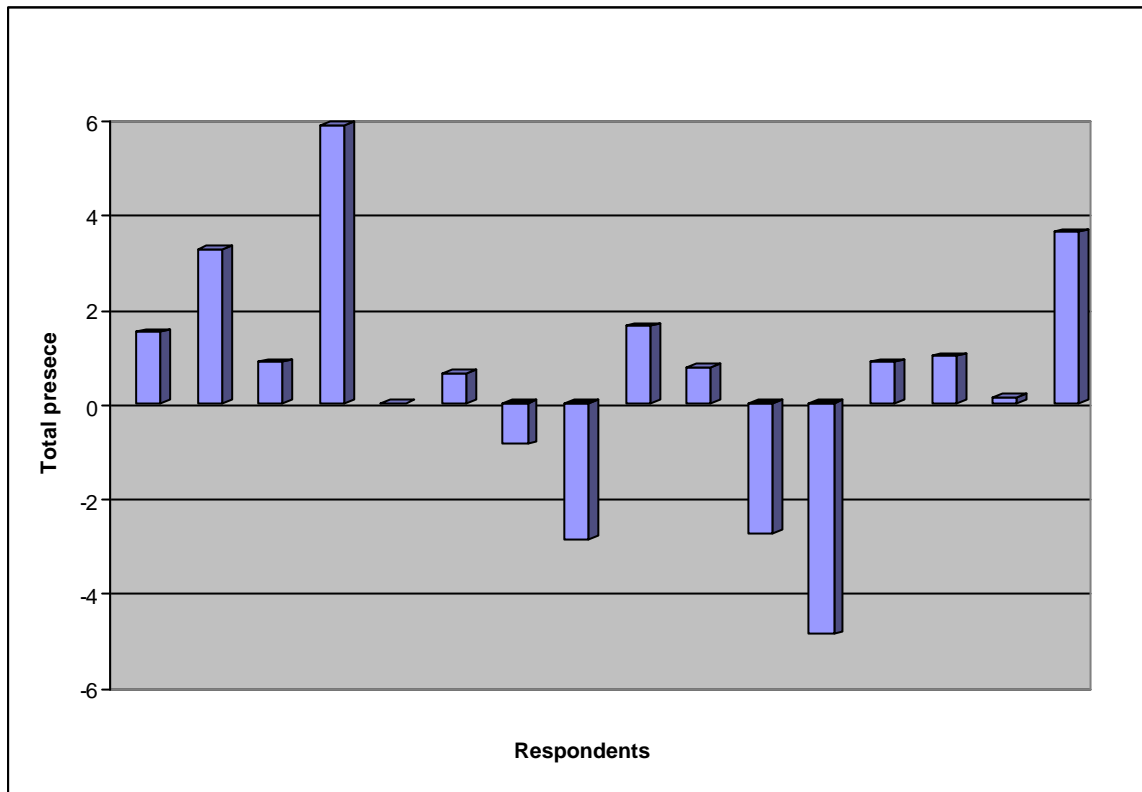


Figure 8 – Individual respondent’s overall presence results

5 Summary Conclusions and Discussion

We were able to draw the following conclusions from the experiment and the results generated:

- *The sense of presence is highly subjective and individual.*
- *When the abstraction level of an experience increases, the feeling of presence decreases. When the abstraction level of an experience decreases, the feeling of presence increases.*
- *Under certain conditions, when the subjective experience of presence increases, the experienced duration also increases.*
- *There was no evidence that presence is inversely related to experienced duration.*
- *Duration estimates cannot generally be used as indicators of sense of presence.*

Our main intention with the experiment was to test the predictions of our three-dimensional model (Waterworth and Waterworth, 2001). The suggestion that presence increases with more concrete processing, but decreases with more abstract processing was confirmed, emphasising the importance of what we have called the focus dimension of experience. But the suggestion that duration estimates can be used as an indicator of presence was not supported.

There was, however, a tendency for duration estimates to be positively correlated with rated presence, but only with content categorised as virtual. With real content, there was no correlation at all. This could be taken as weak confirmation of the validity of the locus (real-virtual) dimension of our model.

There was no evidence that sense of presence and duration experience are inversely related, as Ijsselstein et al. (2001) and Lombard (2000) have suggested.

The overall presence ratings for individual respondents indicate very different ratings after having seen the same film clips. A situation in which one individual will feel very present may create a very weak sense of presence for another individual.

It is not easy to explain why such differences exist, and there is probably more than one factor that influences the level of presence experienced by a person in a certain situation. Part of the explanation relates to the great differences people have reported from experiencing the Illusion of Being itself. Different people respond to different aspects in different ways. Some like the exciting, active scenes, others prefer the more tranquil aspects. Some find the experience frightening, others deeply moving, intriguing, or boring. It seems reasonable to expect that mood and artistic tastes of individuals would affect rated sense of presence. We would expect personal factors such as gender and personality to also have some impact, but given the homogeneity of our respondent sample we are not in a position to judge if this is the case.

While talking to the respondents after the experiment we noticed that individuals who were interested in computers and study or work with computers a great deal, often commented and asked about the equipment used in the experiment. They would talk about the resolution of the visual display, the quality of the sound and such things. The individuals that were not as used to computers seemed to prefer talking about their experiences instead. This could be an indication that people with experience of VR and computers generally pay more attention to the technological surroundings than people inexperienced in this field, in line with the suggestion of Lombard et al. (1997).

Even though the different films used in the experiment created highly significant differences in the respondents' experience of presence, it might be possible to create virtual experiences that have an even larger impact on the experience of presence. It would, for example, be interesting to see if the results of the abstract films would be stronger if the respondents had to do different kinds of problem solving requiring high levels of abstract processing. Following our conclusions about presence and absence, it is likely that this would follow the same pattern and make the respondent feel even more absent than was the case here. This might also have the effect of producing significant variations in subjective duration, as predicted by our model and suggested by some earlier work (Flaherty, 1999; Waterworth, 1983). This remains to be seen, and it should be noted that the field of duration perception is extremely contentious and it remains true that "Time experiments, despite their long history, have advanced little compared with other fields of study." (Orme, 1969, p90).

Sometimes occupants experiencing The Illusion of Being seem to feel extraordinarily present in the environment – more so, in fact, than in the real world. We hypothesise that this is because of the combination of bodily interaction with a sense of physical and social safety, in a personal, protected world. In the Tent we can safely afford to be more present than we normally are in the world, because in the outside world we must almost always reserve some conscious capacity for reasoning about our own safety – both physical and social.

6 Acknowledgements

The Illusion of Being was the result of work by all members of the Tools for Creativity Studio in Umeå. Additionally, sound effects were created by Carl Svensson, the illustration of the Tent was made by Niklas Andersson, and most of the work on the design and physical construction of the Tent itself was carried out by Lars Johansson. The experiment was conducted by Johanna Holmgren and Tomas Rimbark, and parts of their university course essay on this work appear in Sections 3, 4 and 5. We are especially grateful to all the volunteers who took part in the experiment.

7 References

- Flaherty, M.G. (1999). *A Watched Pot: How we experience time*. New York: New York University Press.
- Ijsselsteijn, W.A., Bierhoff, I. & Slangen-de Kort, Y. (2001). Duration Estimation and Presence. Paper presented at *Presence 2001*, Philadelphia, May 21-23 2001.
- Ijsselsteijn, W.A., de Ridder, H., Freeman J. & Avons, S.E. (2000). Presence: Concept, determinants and measurement. *Proceedings of SPIE*, 3959, 520-529.
- Lombard, M. (2000) *Presence Measurement*.
<http://nimbus.temple.edu/~mlombard/Presence/measure.htm>
- Lombard, M. & Ditton, T. (1997). Presence: at the heart of it all. *JCMC* (3)2.
- Orme, J.E. (1969). *Time, Experience and Behaviour*. London: Iliffe Books.
- Schubert, T., Friedmann, F. & Regenbrecht, H. (in press). The experience of presence: Factor analytic insights. *Presence: Teleoperators and virtual environments*.
- Waterworth, J. A. (1983). *The Influence of Variations in Cognitive Processing on the Perception of Time*. PhD thesis, University of Hertfordshire, UK. Available through the British Lending Library (Accession no. D50267/84).
- Waterworth, J. A. (1985). Memory Mechanisms and the Psychophysical Scaling of Duration, *Perception*, 14, 81-92.
- Waterworth, E L and Waterworth J A (2001) Focus, Locus and Sensus: the 3 Dimensions of Virtual Experience. *Cyberpsychology and Behavior* 4 (2) 203-214.
- Witmer, B.G. & Singer, M.J. (1998). Measuring presence in virtual environments: A presence questionnaire. *Presence: Teleoperators and Virtual Environments*, 7, 225-240.

Appendix 1 – Presence Questionnaire

1. Somehow I felt that the virtual world surrounded me.

Fully disagree -3 -2 -1 0 1 2 3 Fully agree

2. I felt like I was just perceiving pictures. (*perceive = uppfatta, märka*)

Fully disagree -3 -2 -1 0 1 2 3 Fully agree

3. I felt present in the virtual space. (*present = närvarande*)

Fully disagree -3 -2 -1 0 1 2 3 Fully agree

4. How aware were you of the real world surrounding while experiencing the virtual world? (i.e. sounds, room temperature, other people, etc.)?

Extremely aware -3 -2 -1 0 1 2 3 Not aware at all

5. I still paid attention to the real environment.

Fully disagree -3 -2 -1 0 1 2 3 Fully agree

6. I was completely captivated by the virtual world. (*captivated = fångslad, förtrollad*)

Fully disagree -3 -2 -1 0 1 2 3 Fully agree

7. How real did the virtual world seem to you?

Completely real -3 -2 -1 0 1 2 3 Not real at all

8. The virtual world seemed more realistic than the real world.

Fully disagree -3 -2 -1 0 1 2 3 Fully agree

Question 4 was changed from:

“How aware were you of the real world surrounding while navigating in the virtual world? (i.e. sounds, room temperature, other people, etc.)?”

This change was made because the respondents did not have the possibility to navigate in the virtual environment in the experiment.