

Probing the Sense of Place

Shaleph O'Neill, Rod McCall, Michael Smyth, David Benyon
 The HCI Group, School of Computing, Napier University, Edinburgh, EH10 5DT
 {s.o'neil, r.mccall, m.smyth, d.benyon@napier.ac.uk}

Abstract

This paper describes the application and results of two studies using a qualitative tool designed to examine sense of place in relation to presence research in the BENOGO project. The 'place probe' incorporates a range of techniques aimed at articulating a person's sense of place, these include: verbal descriptions; sketch maps; salient features; semantic differentials and six words that best describe the experience of being in a place. The paper will describe the application of the probe in both a physical place and a virtual representation of that place. The Analysis of the results reveals a similarity of reported experience in both places, but that the extremes experienced in the physical place were more flattened in the virtual representation.

Keywords--- Presence, Place, Probes, Subjective measures, Empirical studies of place.

1. Introduction

BENOGO is a research project funded under the European Community's Future and Emerging Technologies "Presence" initiative that aims to investigate concepts of presence within the technologies of real-time image-based rendering. One aim of the research is to develop new tools for empirical and theoretical studies of presence based on the concept of the observer's embodiment in the computationally created virtual environment. To do this we are developing new tools for empirical and theoretical studies of presence based on the concept of embodied cognition, or embodiment [4]. As real places (possibly known to the observer) with man-made and/or organic objects (like trees, foliage etc.) are hard to represent in a graphically constructed virtual environment, another objective is to bring about new insight into presence through comparison with the sense of presence experienced in the real world. The new technology of *Image Based Rendering* does not require a reconstructed geometrical model of the scene [3, 16]. It bypasses an important technological problem and presents a breakthrough, but large amounts of image data need to be stored, and recalled for real-time visualization. Thus a third objective of the project is to find ways in which the key aspects of the place can be communicated to

engineers, so that technological constraints do not undermine the subjective feeling of place.

It is contended that the philosophical background of embodiment has two important consequences for the research. Firstly, the sense of presence requires a body; it is not solely cognitive. A body is clearly missing from the experience of many virtual environments (such as those rendered using a head mounted display). Secondly, the requirement to articulate what people are thinking and feeling in order to compare experiences across the real and the virtual. This raises the issue of how to probe people's thoughts about a situation without interfering with the concepts and processes that underpin the experience.

For these reasons and for the more pragmatic reasons of informing the design of our photo-realistic virtual environments, the decision has been made to distance the research from attempting to understand the whole of the complex concept of presence. Instead the work has focused on a key-contributing factor of presence, namely place. The thrust of the BENOGO project is 'to be there without going'; that is to provide people with a realistic sense of being somewhere else. Accordingly the research has focused attention on capturing the essential features of places and finding ways in which to communicate these to the designers and engineers of virtual environments.

This paper reports on the experience of conducting empirical work into understanding and representing a sense of place. A qualitative tool entitled the place probe is introduced and its application in both a real and virtual environment is discussed. The paper presents results from both environments and draws conclusions as to the utility of the probe as a means of articulating discussions concerning the sense of place.

2. Contributing studies

The approach adopted by the BENOGO team from the outset of the research has been to understand place in relation to presence, from a qualitative perspective. As a means of grounding this approach, a range of previously used techniques were explored. A number of these methods were utilized during the initial phase of the BENOGO project.

The Immersive Tendencies Questionnaire (ITQ) was developed to identify real world tendencies (e.g. using computer games) that may affect a person's sense of presence [23]. The ITC-SOPI was developed for the UK's Independent Television Commission. It is a cross media questionnaire, which explores: spatial presence, levels of engagement, sense of naturalness and negative aspects that effect presence [10].

We have also used more open-ended methods such as talk-aloud methods [13], semi-structured interviews and written descriptions of places [18].

Sketch maps [21] are a technique used to elicit people's understanding of spaces, key landmarks and relationships between salient features of an environment.

Finally we have explored the use of repertory grids as a means of gaining access to the meaning a person has attached to their experience and/or properties of the environment. In the repertory grid technique [9] people are asked to describe their experiences according to a number of dimensions supplied either by the people themselves or by the experimenter. Relationships between these dimensions are grouped together and used to arrive at key concepts that describe a domain.

The effectiveness of these techniques has been explored through a variety of data analysis techniques such as grounded analysis, peer reviewing, semiotic analyses and various forms of coding. Furthermore, the utility of these techniques has been studied in a variety of settings such as environmental architecture [17], real and virtual environment representations of botanical gardens a university stairwell and a city view of Prague, all rendered in an HMD [11,12,13].

One of the motivations underpinning the research is to compare virtual representations against real places. Such comparisons can be made at many different levels of abstraction. The comparison of the Prague botanical gardens and the Edinburgh botanical gardens [13] was considered to be valid at the level of general characteristics – the virtual gardens did not feel hot and humid which was a key characteristic of the real gardens. However, many of the plants were of similar shapes and sizes. They were not the same plants, but they provided an overall feel for 'being in' a botanical garden.

The research reported in this paper has provided the best opportunity to 'benchmark' a place and to enable the comparison between a real place and a virtual representation of that place. The place chosen was a city viewpoint in Prague. Of course it is very difficult for the real and the virtual places to ever be exactly the same. In this case, they were experienced at different times of day and with different weather conditions. This impossibility of making a detailed and exact comparison must be born in mind when considering the 'benchmarking' data. However, for the purposes of informing the design of a virtual place that is as faithful as possible to the real place, focusing on the key salient aspects does appear useful.

3. The place probe

The experience of using a variety of data capture techniques in our previous studies indicated that no single questionnaire, or set of questions or other unitary method was going to provide the rich variety of data required to understand the key features of a place. To address this lacking it was proposed to utilize a variety of data capture methods used in conjunction with a range of data analysis methods. Accordingly a 'Place Probe' was created.

Probes have been use recently in two main contexts. Cultural probes [6] for the capture of rich data about the context in which a technology was being used, or where it was likely to be used. The probes were not intended to simply elicit some objective data they were intended to provoke responses. In a similar vein Technology probes [22] have been used particularly in the domestic setting to explore new uses of technologies. These probes used methods that informed the design of a prototype system for a common interface where different generations within a family could communicate irrespective of physical location. Information was captured about the nature of communications between family members. The probes contained a communication diary, notebook, two disposable cameras, address envelopes and a pen. Probes have also been used in other design and evaluation situations [5] and [2] to explore domestic environments.

The probe reported here differed in that it was designed to capture experiences at a specific point in time or a particular place rather than over an extended period of time. Drawing on the experiences of the previous empirical studies it was decided to include the following instruments within the probe.

3.1 Probe part 1: the visitors book

Research undertaken by Turner and Turner [20] has highlighted the written reports contained in visitor's books as a source of rich data about place. Indeed such reports have the advantage that they are often ask open-ended questions e.g. 'Please tell us about your experience' rather than 'Tell us about the lighting', hence they do not prompt people to provide answers on specific topics.

3.2 Probe part 2: sketch maps

Sketch maps are a technique used to elicit people's understanding of spaces, key landmarks and relationships between salient features of an environment. In this case accuracy of the map is not of prime concern, rather it is the depiction of those aspects of the place that people remember for example a tree, building or seating area. They can also be used to provide additional information such as where people are standing or their paths through the environment.

3.3 Probe part 3: salient features

This section of the probe asks for participants to rate the three most salient features of the environment. The aim of this is establish the most important visual benchmarks in the real world that should be identifiable in the virtual one.

3.4 Probe part 4: semantic differentials

This part of the probe combined Osgood's semantic differentials [14] and Relph's three aspects of place (physical features, activities afforded and affect engendered). The objective is to gauge people's feelings towards the environment based on their responses to the differential scale. For example people are asked if the environment is attractive or ugly, with the rating ranging from Very Attractive, through neither (i.e. not attractive or ugly) to Very Ugly. Responses to this section therefore result in a gauge of how strongly or weakly participants rate their experiences of the environment within the scales provided.

3.5 Probe part 5: six words

The final part of the probe asked people to write down six words which best described their experience of being in a particular place. These were used to establish themes that emerged across participants based on the relationships between the words and their synonyms.

4. Data analysis methods

A grounded theory approach to data analysis was adopted, the objective being to uncover common aspects of the scene from the varying sources of data. Having uncovered the common themes these were categorized in terms of models of place derived from environmental psychology offered by Relph [15], Jorgenson [8] and Gustafson's [7], particularly Relph and Gustafson. This allowed us to study the utility of these models in the context of the current research [18,19].

4.1 Inter-rater reliability

The range of comments found within the descriptive paragraph resulted in it being open to a high degree of interpretation by each evaluator. To combat this, random samples of comments were analyzed by all three evaluators, during which time common themes were found to be emerging.

One evaluator analyzed the sketch maps for salient aspects such as named locations/objects, or easily identifiable locations. There was obviously some degree of interpretation within sketch maps, as a result a random sample of ten were given to two other evaluators to check for inter-rater reliability within the data. Maps contained only basic drawings of the cityscape, therefore rather than attempting to categorize each building this

was placed within the 'general city or cityscape' category.

For the semantic differentials it was decided not to calculate medians or means as they provide only a very crude indicator. Rather it was decided to count the number of responses in relation to each point within the differential scale. This data was used to corroborate data found within other data capture methods. However the main objective was to capture data that could be used to benchmark the real and virtual scenes.

The place probe has been used in three real world environments and two virtual environments. There is no doubt that it does indeed capture important characteristics of places. In the following section we report on a comparison of a real city viewpoint and on a photo-realistic image rendered through a head mounted display with full head-tracking and simulated stereo vision.

5. Study 1: the viewpoint, Prague

The first use of the probe was in Prague during December 2003. The viewpoint is one of Prague's largest single green spaces (with many trees) and it is ideal for quiet walks and breathtaking views over the city of Prague (Figure 1).



Figure 1. View of Prague from the Hillside Viewpoint

The viewing platform (where the study took place) is situated on the top of this hillside and is accessible from the road by climbing up a number of very steep steps. It is an open circular space, which is partially surrounded by a hedge, a few benches and a sheer drop to the front of the platform. There is a statue of the Virgin Mary to the rear of the platform, a plaque to the front and a monastery and house in the surrounding local background. The view is spectacular and it looks out over the entire of Prague city, exposing some of the city's most famous landmarks.

A total of 30 (14male/16female) people took part in the study, with ages ranging from 15 to 58. The group contained a range of nationalities including Czechs, English, Swedish and German. Where possible a probe in the first language of the participants was provided, the only exceptions being Spanish and Swedish, however neither group seemed disadvantaged by having to use the English version.

At the hilltop view, members of the public who were visiting the area were asked to complete the presence probe. Each person was told it would take around 15 minutes and they would be paid 150CZK (around 5 euros). Participants were informed that the study was interested in their experience of the place.

5.1 Descriptions

Recall that in this section, participants were asked to write a free-form paragraph describing their experience. They were not prompted to focus on anything in particular. Below is a typical example of the data gathered from the description section of the probe:

“A gray mist is covering Prague, my fingers are bitterly cold but still the magnificence of Prague cannot be covered. I was standing on the hill, which the castle is on, and it was facing the new town, the Volta River and the old town in the distance. All the most beautiful landmarks are visible and I felt totally happy and contented to be there”. (22,female, Singaporean, first time at the viewpoint)

It is interesting to note that the three levels of description from Relph’s model of place [15] occur quite naturally in such descriptions. There are comments on the physical aspects, the activities offered and affective characteristics of the environment. Other descriptions typically followed this pattern.

5.2 Sketch maps

The sketch maps drawn by the participants in the Prague study contained a great deal of detail. The buildings, landmarks and other physical aspects of the environment were very descriptively drawn with the shapes and types of buildings made evident. Particularly most of the maps highlighted the cathedral, cityscape, statue, walkways/paths, monastery, hillside, platform and trees, along with labels identifying their names. Figure 2 is an example of the kind of sketch maps that were drawn by the participants in the Prague study.

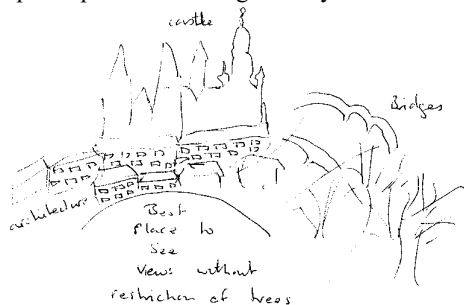


Figure 2: A typical sketch map from the Prague Study

5.3 Salient features

In this section of the probe, the participants seemed to rank the view, the castle and their feelings/impressions

of the place (i.e. quiet, peaceful) as the features of most importance. Overall, the castle featured more dominantly than any other feature (12 times out of a total of 30). The view was mentioned on ten occasions with references to it ranging from a ‘fantastic’ view to a ‘wide’ view to a good ‘view’. The platform, river, nature and trees were also frequently mentioned. While the hill, Charles Bridge, the statue, St. Nicolas church, buildings and monastery were less frequently mentioned. Feelings and expressions of openness and niceness were noted throughout the responses and the overall impression was quiet, peaceful and clean with noted sounds of dogs and birds.

5.4 Semantic differentials

Below is a table indicating the participants’ responses to the semantic differentials. The numbers are given as a direct count from the probes. This section of the probe allows participants to rate their experiences of the environment in relation to scales that are based on data from our previous rep-grid studies and from Relph’s model of place:

	Very	Quite	Neither	Quite	Very	
Attractive	23	3	1	1	1	Ugly
Big	7	12	6	2	1	Small
Colourful	5	12	8	4		Colourless
Noisy	4	8	5	8	4	Quiet
Temporary	1	7	6	8	7	Permanent
Available	4	11	10	4		Unavailable
Versatile	2	11	8	7	1	Limited
Interactive	5	8	5	6	5	Passive
Pleasant	23	5			2	Unpleasant
Interesting	19	6	2	1	1	Boring
Stressful	1	1	3	4	20	Relaxing

5.5 Words

The words were categorized in terms of semantic similarity, where a grounded approach was used to identify emerging themes that appeared again and again.. Interestingly, the strongest themes bear some similarity to those used in the semantic differentials while others are more specific to the environment. Below are examples of responses together with the themes under which they were categorized.

Peaceful/ Relaxing: Quiet, relaxing, peaceful, calm, tranquil, silent.

Interesting: Interesting, educational, enthusiastic, curious, engaging, absorbing, captivating.

Beautiful: Beautiful, nice, pleasant.

Cityscape: View, cityscape, scenic, outlook, sky, open, endless remote, distant, roofs, castle, town, people, noise, monuments, atmosphere.

Enjoyment: enjoyment, contentment, happy, satisfaction, worthy, fulfilled.

Amazement: surprised, overwhelming, amazing, powerful, impressive, mighty.

Cold: cold, damp, autumn, gray, cool.

Nature: nature, birds, life, environment, trees, river.

Refreshing: fresh revitalizing, bright, freedom, recovery, escape, vibrancy, clean, fresh air.

5.6 Prague viewpoint results

Taking all of this evidence together, what emerges from the data in the Prague study are a set of themes that can be grouped in accordance with both Relph's [15] and Gustavson's [7] models of place. At the most general level these are the physical attributes, activities and the emotional or affective aspects of the place.

The physical attributes of the environment included: The Statue, The Benches, Paths and stairs, Platform, Plaque, Background buildings, Trees, Birds, Hillside, Cold, Local Sounds, Distant Sounds, Cityscape.

The activities that the participants engage in while they were in this environment are generally: Looking at the cityscape, exploring, and moving about.

The affect that the environment had on the participants i.e. the types of feelings, emotions, memories and other experiences that the participants offered in relation to their experience of the immediate environment were: Enjoyment/Contentment, Refreshing/Re-vitalizing, Interesting/Engaging, Peaceful/Relaxing, Amazement, Beautiful.

6. The BENOGO virtual viewpoint

The BENOGO VR (Figure 3) environment was a representation of the viewpoint in Prague rendered using BENOGO's real-time IBR (image based rendering) software. The system in itself comprises six networked computers running as a cluster, a head mounted display (HMD) and eight speakers providing surround sound. The system is set up in a darkened room where all of the participants take part in the studies.



Figure 3: Viewpoint Mosaic created for the Head Mounted Display

BENOGO IBR offers the unique advantage of real-time rendered images for a moving observer in a virtual environment. This requires a lot of computing power.

While the cluster did provide this, it came with restrictions caused by the bandwidth of the network, that at the time unfortunately reduced the performance of the IBR technology slightly (more recent demo's of BENOGO IBR have resolved this issue).

While the real-time IBR technology offered very realistic parallax motion, the environment had an overall feel that lacked detail and had a tendency to jitter, this was partially due to the restrictions previously mentioned and partially because of the way the images are rendered and 'stitched' together in real-time. The images themselves were of high quality and depicted the viewpoint scene in Prague on a sunny spring day with a clear blue sky and no leaves on the trees. The buildings close by, the statue, the hedges and the platform itself were all clearly identifiable. However the resultant lower resolution of the real-time IBR meant that the images in some way looked less detailed, particularly the distant buildings of the cityscape.

Those who took part in the study in virtual environment were instructed on how to use the HMD and then told to explore and experience the environment. They were made aware of the movement restrictions of the HMD but encouraged to move freely within the available space. They were also told that they would be immersed in the virtual environment for a period of time and that they would be informed when that time was up. When the time was up they were helped out of the HMD and taken through to a separate room where they undertook the probe questionnaire. After this they were offered some light refreshment as reward for taking part in the study.

6.1 Descriptions

Below is a typical example of the data gathered from the descriptive section of the probe. In general the responses to this section identified aspects of the virtual environment as well as distortions, glitches and resolution problems with the IBR rendering. Interestingly, there was a distinct lack of emotional responses to this section of the probe compared to the real viewpoint:

"The view was from a hill overlooking a city in southern Europe on a sunny day with birds and some church bells in the distance. I was standing on a paved circle with a statue behind me. The picture was a bit blurry especially the trees. Perspective seemed natural. There were camera/lens reflections hanging in mid air behind me, though it was not possible to see the sun only a white sky". (24, male, Danish, First time user of HMD technology).

6.2 Sketch maps

The sketches drawn by the participants in the VR study were markedly simpler than those in the real environment. While key features were still identified and

arranged in a similar way, in most of them, a large amount of detail remained lacking (Figure 4).

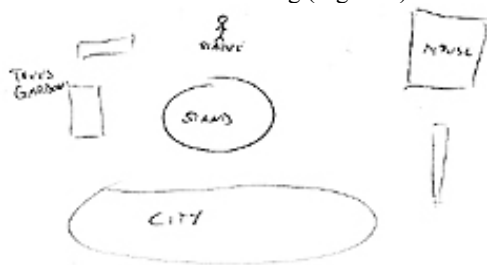


Figure 4: Sketch map of the Virtual Viewpoint

6.3 Salient features

In the virtual studies, the participants seemed to rank the church, castle, city and statue as the most important features. And overall, the statue/sculpture was most frequently noted (15 times), then the church (11 times) and the castle (8 times)- bearing in mind there has been some discrepancy over what people were calling each of these buildings (i.e. some called the church a castle and visa versa). The view was mentioned on six occasions as was the large white house /monastery. To a lesser extent birds, platform, city, trees, bench, camera stand, roofs and sunshine were noted. Some participants made a note that it was difficult to see the details in the environment and there was a mention on two occasions about the feeling of quietness.

6.4 Semantic differentials

Below is a table indicating the participant's responses the semantic differentials. Again, this section of the probe allows participants to rate their experiences of the environment in relation to the scales provided. The numbers are given as a direct count from the probes.

	Very	Quite	Neither	Quite	Very	
Attractive	7	15	7			Ugly
Big	2	11	13	2	1	Small
Colourful		14	5	9	1	Colourless
Noisy	3	7	9	6	4	Quiet
Temporary	3	6	8	8	4	Permanent
Available	1	9	11	5	2	Unavailable
Versatile	2	6	12	7	2	Limited
Interactive	1	7	6	10	5	Passive
Pleasant	4	16	5	4		Unpleasant
Interesting	8	11	5	4		Boring
Stressful		5	5	11	8	Relaxing

6.5 Words

In a similar manner to the Prague study, a number of themes emerged from the words used by participants to

articulate their experience of the virtual viewpoint. Below are examples of responses together with the themes under which they were categorized.

Peaceful/relaxing: peaceful, serene, quiet, relaxing, harmony, calm, tranquil.

Grainy: blurry, hard grained, coarse grained, fragmented, grainy, unclear, low resolution.

Weather: summer, warm, sunny, cold, windy.

Mediterranean: Greek, Spanish, vacation, holiday, south, family.

Beautiful: beautiful, nice, pleasant

Restrictive: want to move, inability to join in, non-explorative, restricted, captured, limited, stuck, static, locked up.

Sounds: birds, crows, ambulance, sound fall, church bells, church time.

Interesting: interesting, curious, exciting, fun.

Realistic: realistic, real, semi real.

Faded: faded colours, lack of colour, not colourful.

Lonely: lonely, loneliness, solitude alone.

Stressful: stressful, annoying, confusing, frustrated.

Natural: natural, blue sky, trees, outdoor.

Viewpoint: viewpoint, view, skyline.

While some of the categories are the same as the real environment the most notable difference is the emergence of themes that refer directly to technical aspects of the VR experience.

6.6 Results from the VR viewpoint

Considering all of the sections of the probe together, themes emerge from the data in relation to Reph's and Gustafson's models of place mentioned earlier.

In a similar way to the Prague viewpoint study the predominantly physical attributes of the environment include: The Statue, The Benches, Paths and stairs, Platform, Plaque, Background buildings, Trees, Birds, Hillside, Grainy/blurry, Realism, Sounds, Cityscape, People, Weather.

The activities that participants engaged in while immersed in the VR environment were, to a certain degree, either static or restricted in some way by the technology itself or by the quality of the images: Standing, restricted movement, restricted looking, blurry images.

The affect that the environment had on the participants offered a great deal of interesting themes in relation to both the emotional affects and other experiences evoked by exposure to the VR environment. In particular references to Mediterranean countries and vacations were quite different from those in the real Prague study: Interesting/Exciting/Fun, Nice/Pleasant/Beautiful, Peaceful/Relaxing, Stressful, Restricted Movement, Mediterranean, Holiday, Dizziness, Loneliness.

7. Comparing the results

The Themes that emerged across both environments were predominantly those ones related to the physical/visual make up of the environment, with some of the affective ones also translating well. While the quality of images in the VR environment was clearly an issue participants still identified and located the buildings in and around the view. However due to the lack of resolution and also the fact that they had not actually been visiting Prague they were unable to name the specific buildings and tended to generalize about the nature of the city rather than 'pick out' specific locations.

Themes such as Peaceful, Interesting, Beautiful and Nature also appeared in both studies, as did Cold and Viewpoint to some extent. The themes that appear in the real world but not in the virtual are: Enjoyment, Refreshing and Amazing. This shows the lack of a positive emotional affect on the users of the virtual world that was a particular aspect of the real viewpoint.

Themes that appear in the virtual world but were not part of the real world were Grainy, Restrictive, Faded, Realism, Stressful, Lonely and Mediterranean/holiday. These themes often point to the technical aspects of the VR environment highlighting problems that interfere with a sense of place. More significantly however they highlight some emotional responses to the VR viewpoint that were very different to the experiences of people in the real environment. These responses may be directly linked to the technical aspects of the environment such as restricted movement and low resolution that combined to frustrate participants. Also, responses that resulted in the emergence of the Mediterranean/holiday theme show the impact of participants not knowing the specific location of the place they were visiting. This highlights the connotative aspects of the IBR rendered environment.

Looking at the two semantic differential tables specifically, what is immediately noticeable is the shift from the extremes in the real environment towards the middle for the virtual environment. This suggested that the real environment had a much more powerful affect on participants than the virtual one. Breaking it down into the three main connotative sections it becomes obvious that the real environment was considered to be more attractive, felt bigger and was more colourful than the virtual one. There is no clear response to the noise differential or the perceived permanence of the place in either environment, although there was a slight trend towards the more permanent in the real world.

With regards to the participants responses to the activities section of the differentials, there was a shift, if however slight, away from the extremes. In the real environment the trend was towards experiencing the environment as quite available, quite versatile and quite interactive. In the Virtual environment there was a move towards neither available nor unavailable, neither

versatile nor limited. There was also an opposite trend towards passive rather than interactive, which was a very different response to the real world.

In the last section, as in the first there were more positive responses. All three factors show similar positive trends towards experiencing the environment as pleasant, interesting and relaxing. However there was a difference between them in that the responses to the real world were much more positive than in the virtual one.

What the data from the two studies appears to show is that the participant's experience of the virtual representation are similar to those of the participant's in the real environment but that the responses are less positive. That is to say that the virtual world does not have the same intensity of affect on the participants as the real environment does.

Although participants clearly responded to parts of the probe in similar ways in each study, there are clear differences between the two. While the virtual environment was able to recreate a sense of peacefulness, beauty and interest similar to the real place, it was unable to recreate the refreshing sense of enjoyment and amazement that the real place engendered in the participants. Indeed it would appear that this type of experience in the real world has been replaced in the virtual one by a sense of stressful loneliness brought on by the lack of realism or intensity in the faded, grainy images and restrictive nature of the virtual environment.

8. Conclusions

This paper has discussed the application of 'The Place Probe' during the evaluation of a real and virtual environment. The aim of the probe was to capture data about the real world that would be of use to the designers of virtual environments attempting to recreate real places. An explicit intention of the probe was to find out what was missing from any experience of a virtual environment when compared to its real world counterpart, rather than simply provide a quantitative score for place or presence. It is contended that such an approach when combined with traditional methods such as ITC-SOPI and ITQ will provide a greater insight into level of presence experienced by people, and how this is affected by their sense of place. The method is qualitative in nature and that of course introduces a series of issues with data interpretation, capture and reporting. However it is believe that by using appropriate methods of inter-rater reliability and that the multiple sources of data within the probe overcome some of the issues with qualitative data.

Analysis of the data generated by the probe suggested that people were having broadly similar experiences in both the real and virtual environments of the same location. Furthermore the data highlighted both technical and non-technical issues that affect the desired objective of re-creating a real place in virtual reality. In that sense the subsequent analysis was able to report to

the technologists/designers of the virtual place about what was lacking in the IBR environment (e.g. sufficient resolution through to other issues such as lack of other people, and how this created a sense of loneliness). Furthermore a series of attributes have been identified which should be addressed in future designs. Moreover, the types of issues found in many cases can be expanded upon and it is our intention to use these themes as templates that can be provided to the developers. Templates are envisioned as early patterns, in a manner similar to Alexander [1] that can provide information on features of a space and will provide information on the technical aspects that may alter their affect and implementation.

In conclusion, the 'The Place Probe' provided a method of exploring real and virtual places and demonstrated the potential to make a valuable and timely contribution to the design of virtual places. The technique has been successfully used to compare the similarities and differences between a virtual environment and its real world counterpart, as well as to identify areas of both strength and weakness within a virtual space. From a technical standpoint it is a technique that can highlight areas demanding technical solutions, for example the requirement to increase the resolution of some objects, as they are deemed more important to that scene. While the probe continues to be refined the initial indications are positive in terms of its potential for contribution to the design, implementation and evaluation of photo realistic virtual environments.

9. Acknowledgements

The authors would like to thank all members of the BENOGO project for their input and co-operation with the studies mentioned in this paper. <http://www.benogo.dk>

10. References

- [1] C. Alexander, *A Pattern Language*, Oxford University Press, New York. 1977.
- [2] L. Baillie, D. Benyon, C. MacAulay, & M. Petersen, Investigating Design Issues in Household Environments. *Cognition Technology and Work* 5(1) 33-44. 2003.
- [3] C. Buehler, M. Bosse, & L. McMillan, "Non-Metric Image-Based Rendering for Video Stabilization." *In Proceedings of the 2001 IEEE Computer Society Conference on Computer Vision and Pattern Recognition 8-14 December 2001 Kauai*, Hawaii USA. 2001.
- [4] P. Dourish, *Where the Action Is*, MIT Press, Cambridge. 2001.
- [5] B. Eggen, G. Hollemans, & R. van de Sluis, Exploring and enhancing the home experience, *In Cognition Technology and Work* 5(1) 44-54. 2003.
- [6] B. Gaver, T. Dunne, & E. Pacenti, Design: Cultural Probes. *Interactions* 6(1) 21-29. 1999.
- [7] P. Gustafson, Meanings of Place: Everyday experience and theoretical conceptualizations. *Journal of Environmental Psychology* 21. 5-16. 2001.
- [8] B.S. Jorgensen, & R.C. Stedman, Sense of Place as an Attitude: Lakeshore owner's attitudes towards their properties. *Journal of Environmental Psychology*. 21. 233-248. 2001.
- [9] G. Kelly *The Psychology of Personal Constructs* New York: W W Norton. 1955
- [10] J. Lessiter, E. Freeman, E. Keogh, & J. Davidoff, Development of a New Cross-Media Questionnaire: the ITC-Sense of Presence, *3rd International Workshop on Presence*. 2000.
- [11] R. McCall, S.J. O'Neill, & F. Carroll, Measuring Presence in Virtual Environments. In *proceedings of CHI2004, Vienna, Austria*. 2004.
- [12] R. McCall, S.J. O'Neill, F. Carroll, D.R. Benyon, The Presence Probe. *In Workshop on Designing and Evaluating Virtual Reality systems*, University of Nottingham, UK. 2004.
- [13] S. O'Neill, & D. Benyon, A Semiotic Approach to Investigating Presence. In *COSIGN-2003* University of Teeside UK, Middlesborough. 2003.
- [14] C. E. Osgood, P. H. Tannenbaum, & G. J. Suci. 1957 *The Measurement of Meaning*. Urbana: University of Illinois Press.
- [15] E. Relph, *Place and Placelessness*, London: Pion Books. 1976.
- [16] H. Shum, & S. Kang, A Review of Image-Based Rendering Techniques. *SPIE Int. Conf. On Visual Communication and Image Processing*, 2-13. 2000
- [17] M. Smyth, Articulating the sense of place experienced by visitors to the Jencks landform *Workshop on Space, Spatiality and Technologies, Edinburgh, 12th-13th December*. 2003.
- [18] P. Turner, & S. Turner, Place and sense of place. *Submitted to Presence: Tele-operators and Virtual environments*. In submission.
- [19] P. Turner, S. Turner, & F. Carroll, The Tourist Gaze: Towards Contextualised Virtual Environments. In P. Turner and E. Davenport (Eds.) *Spaces, Spatiality and Technology*. Kluwer. To appear.
- [20] P. Turner, & S. Turner, Two Phenomenological Studies of Place. In *the Proceedings of The British Computer Society Annual Conference on Human-Computer Interaction (BCS-HCI)*. Bath, United Kingdom, 8-12 September. 2003.
- [21] B. Tversky, Spatial mental models. In G. H. Bower (Ed.), *The Psychology of Learning and Motivation: Advances in Research and Theory*. Vol. 27 (pp. 109-145). N. Y.: Academic Pres. 1991
- [22] B. Westerlund, S. Lindquist, & Y. Sundblad, Cooperative design of communication support for and with families in Stockholm - communication maps, communication probes and low-tech prototypes. *First Equator IRC Workshop on Ubiquitous Computing in Domestic Environments, Nottingham, 13-14th September*. 2001.
- [23] B.G. Witmer, & M.J. Singer, Measuring Presence in Virtual Environments: A Presence Questionnaire, *Presence* 7(3), 225-240. 1998.