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**Environmental psychology test: Comparing small computer screen
with Virtual Reality – lab situation as presentation technique for
different forest diversities.**

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Abstract

Most environmental psychology tests are performed using a standard computer screen or projectors. We have in our study investigated the effects of using VR-lab technology and techniques showing static photos, compared with standard computer screen. Forty-two persons have participated in our tests, equally divided between the two setups. Four images have been used for the test, showing four different forest environments, with three different degrees of diversities. The same forest diversity classifications are used in an ongoing study at Lund University, Sweden, investigating how human's responses towards biodiversity are related to attitudes towards conservation. Our results, surprisingly, show no statistically significant difference between the different presentation methods. However there are indications that the presentation method has different effect on the different diversities.

Introduction

Our aim for this study is to investigate if screen size affects people's experience of an environment. In Lund Sweden there is an ongoing study that has shown that a different degree of biodiversity affects people's emotional response. Their study compares the responses to a small screen with taking the participants to the real environments. Their expectations were that the real environment would give greater emotional responses. In our

case, we have an opportunity, because of the VR-lab at UMB, to simulate a more real situation using a big curved screen, but keeping the advantages of staying indoors in a controlled lab setting.

We have chosen to use images of different biodiversities as done in the Lund study because we want to see if the pictures will give different result presented on different screen types. We have not used the same pictures, but selected our own

from environments close by. We know that there will be some difference between our test and the study in Lund, but we want to look further into what kind of differences there are.

Photographs have been by far the most common medium in preference survey models. But the ability of these kinds of media has been criticized much in the setting of representing dynamic multidimensionality of real landscapes.

The strongest limitation in use of photographs is the lack of control of the content of the image. Photographs are usually selected to show variations or presence/absence of the feature of interest to the survey, but control is crucial for avoiding noise in results. This noise effect is suspected to be strong from cultural elements, like walking paths or human constructions. To avoid this effect, photo manipulation has been the most common approach to control the images.

The virtual reality (VR) presentation gives us new possibilities for showing landscapes. This new technology brings new possibilities for showing environments. Computer visualisations bring new opportunities for controlling the content of the images and for modelling future scenarios (Daniel and Meitner 2001). Virtual reality presentation opens up the opportunity to design walk-through surveys, full-field-of view and sound as important features which could increase validity (Bishop et al. 2001). Orland et al. (2001) stated that the new virtual reality tools added immersion, motion and

sound to the scenic view representation, which could allow for a deeper or more meaningful study of the real world on human experience.

The most common use of the VR-technology has been to show 3D models, but using these techniques would still just show models that close up clearly is not real scenarios. Especially for us comparing different forest diversities the impression would most probably be different from a model and from a picture.

In this study we will look closer into how this technology can benefit 2D image presentation. If this works we could make this kind of research more efficient, both in cost and content. For example it is almost impossible to bring a test group to “hundred” different kinds of environments. The cost would be very high, and the elements like wind, sun, temperature etc. would probably influence the result. In a VR-lab, such as ours, we can control these elements. We are also able to show many images in a short time period. This would really benefit this kind of study.

Method

The environments:

The first thing we needed for this study was to find environments for our tests. As in the test in Lund we would use three different diversities. We should also use pictures that did not vary too much from each other in expression. This we did to avoid

noise that could affect the result. Finally we wanted to use local landscape types. This would make it easier for us to go back to the scene, and also we would get an environment that was familiar to the test subjects.

As mentioned we have used three different diversities as the basis for the photos. Low-, middle- and high diversity. Doing this will make it possible to compare the screen size used with the environment showed and see if there are any apparent differences in the results.

To find good examples close by, we went to the local government for information of different locations in the region. We got some suggestions and started investigating the environments there and possibilities to get decent photos. After deciding on a set of locations and viewpoints we travelled around with our camera and took numerous pictures in different locations so we had a good variation to select from.

The photo-shoot was done in the middle of October. Because of the season it was especially important to get all the pictures taken during a short time period. This because of the rapid changing environment at this time of year. The weather should, likewise, be similar in the pictures, so the effect of greatly different situations in this respect would not inflict the emotional impact on the test subject.

Getting the photos:

The pictures we used were taken with a Canon EOS 30d, a digital single-lens reflex camera. All the pictures used in the test were taken using a wide angle lens, Canon EFS 10-22 mm. We used a tripod while taking the pictures. This to avoid unstable photos and to get the exact same position for all the pictures taken at the same viewpoint. The pictures were taken in Canon RAW format (CR2) for best result.

The screen at the VR-lab we were using has a resolution of 3840x1805 pixels. To get the right format that matched this very wide screen we needed to take several pictures, side by side, at every location, which we would then merge together digitally. Locking the shutter speed, aperture, focus point and focus length we got the same light conditions and view area in the concurrent pictures.

Using designated software we stitched the photos together. Putting together two pictures, and three for some panoramas, creating the correct size and view. We used several programs to process the pictures. Firstly, converting the RAW-format file to high quality jpeg, was done with Canon Digital Photo Professional. Then we stitched two or three pictures together with Canon PhotoStitch. In the end the pictures was altered and adjusted with Adobe Photoshop and Google Picasa3.

One problem that presented itself with the process of taking and getting the pictures ready was the

perspective distortion that appears when using a wide angle lens. Because of the relative cramped areas in which we were photographing, in forest and with obstructing landforms, we needed to use a wide angle lens to get the whole scenery, from close up, without losing the ground or the sky from the view.

This lens, when going very wide, tends to distort the perspective as it closes to 180 degrees view.

This is especially apparent at the edges, and when putting together two photos, the right side of one with the left of the other, the perspective is distorted in opposite directions for the two. This makes it especially hard to merge them together without getting miss matching. We overcame this problem by not using the examples zoomed all the way out to wide, and also by adjusting the results manually in Photoshop to fix the miss matching.

The pictures:

We decided to use four different pictures, one from each of the three diversities, and the last an addition with more apparent human influence and more mixed forest type, to see if it gave any different results. Following is the actual pictures with a short comment.



Fig 1: Forest with low diversity. The ground vegetation is low, and there is almost no vegetation in the middle layer. The main vegetation is trees, mainly trees of one sort.



Fig 2: Forest with middle diversity. Here we can see that there is more than just one type of trees in the tree layer. We can also see that there is more vegetation in the middle layer, but poor diversity in the lower layers.



Fig 3: Forest with high biodiversity. Here there are many vegetation species in every layer. This type of forest is on a very moist and nutrient ground. Often close to rivers and creeks.



Fig 4: This photo is our control image. Here we see a forest of low diversity, but the forest on the right side in the image is of an industrial sort, and the one on the left side is more natural.

Participants:

For our tests we chose to use students from our university. We did this to get participant groups that were most alike in age and similar in background knowledge.

For the VR test we emailed different institutes with an invitation for students to join our experiment. As it turned out we got most of our replies from the Department of Landscape Architecture and Spatial Planning (ILP) and a few from The Department of Ecology and Natural Resource Management (INA).

For the computer test we used students from one of the courses here at UMB, that one of us was a guide for. Voluntaries from the class could take the test. This was also students from ILP but none of them took the VR-lab test.

We managed to get 21 participants for the VR-lab, and the same for the computer labs. Out of these there were 12 females in age between 22 and 32 (25.25 average) and 9 males between 22 and 34 (26.4 average) for the VR-lab. In the computer test there was 5 males between 22 and 29 years old (25.6 average), and 16 females between the age 19 and 25 (21.8 average).

Two different tests:

The pictures were to be shown in two different settings which had different demands.

The small screen setting in the computer lab presented no problems. It was easy to show any kind of 2D picture and the resolution would only change the amount of the screen that was used.

Concerning the test at the VR-lab, there were issues with how to get the pictures shown on the panorama view screen. Even though the pictures were the right size it presented problems placing it on the curved screen.

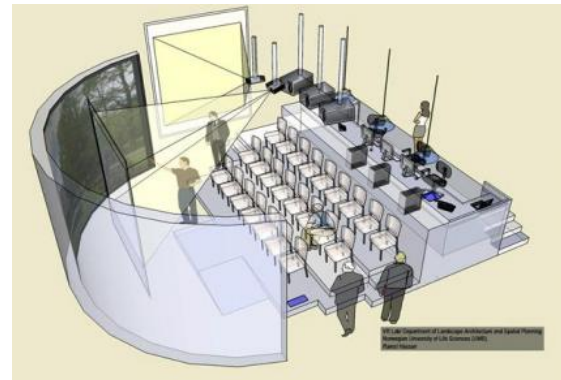


Fig 5 and 6: Drawings showing the setup of the VR-lab we were using, and the curved screen.

The VR- lab at UMB consists of three Stereoscopic projectors projecting images to a screen curving 180 degrees around an audience of maximum 24 people. There are two visualization systems running on the VR-lab: a 2D and a 3D visualization systems. The 3D system is used for

showing 3D models. The 3D system is the main system running at the VR-Lab. The 2D visualization system was developed later for various tastings. The 2D system was not an option for us to use because it is, first still underdevelopment, and second the resolution of the graphics are not as good as the 3D system. In addition, blinding and wrapping process of an image on the 2D system by using three projectors with a cylindrical screen is time consuming. Therefore, we decided to make use of the 3D system.

Because of the above mentioned situation with the 3D system showing a view into a 3D world there is no apparent way of draping a 2D picture over the screen which is curving. The provider of the VR-Lab hardware and software couldn't provide us with a technique for showing an image using the 3D visualization system. We decided to come with our own way for creating an image that could match the size and proportion of the large curved screen. The solution was to create a 3D model of the large curved screen and drape the image on it. At this stage we used Google SketchUP for modeling. The pictures we were going to use on the test were put on the surface as painted one.

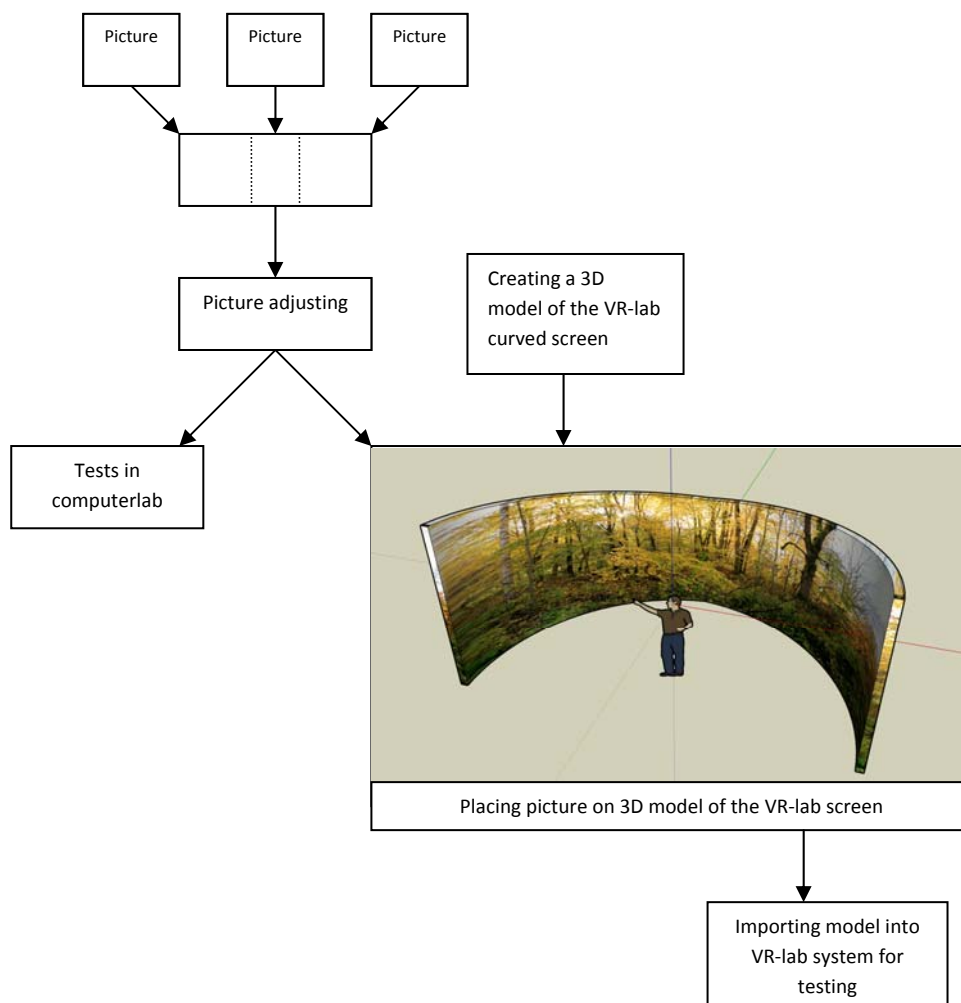


Fig 7: The figure shows the process of managing the photos, and adjusting it for both tests

Then the viewpoint was placed in eye height (1,8 meters above the bottom of the model). The viewpoint was also placed 3 meters out from the middle of the concaving curve (see figure 7).

We could now place the model into the VR-lab as a 3D model, and use the system with no special adjustments. In this way we also got the stereoscopic view as with any model, which gave us a slight 3D immersion effect in combination with 3D glasses.

Eon Reality is the software that is used for running the 3D system at VR-Lab. When showing the pictures in the above mentioned way, we used this software when walking around in a model. This was done by moving the mouse for walking forwards and looking sideways and so on.

When moving forward we were actually walking towards the model, and looking left or right actually turned the virtual person. Using this technique we could move around in the picture in a fluent and nice way, giving the feeling of immersion and moving around in the landscape.

Test form:

We have used a form called Basic Emotional Process based on the HEI model developed by Küllers (Johansson and Laike 2007, Küller 1991 and 2004). This form has the purpose of registering the emotional response of the test subjects.

The form was translated from Swedish to Norwegian before the test.

The audience is instructed to look at each picture and think of being there for one hour. Then they should mark the answer that was most suited for their emotion.

The form is based on adjectives that represent different emotions. For each adjective there is a line with four choices of grading that emotion. For example: very tired, quite tired, quite rested and very rested. This was the choice for one of the lines, and the participants had to choose only one of four alternatives. Other adjectives were; angry, strong, interested, sleepy and so on.

Test procedure:

Shortly before both tests a short presentation of the study aim and what the participants where to do was given. But no explanations was given on what they where to see, or on the subject of different diversities. In all we gave as little information as possible on what the test was about, except that it was an environmental psychology test comparing results from the VR-lab and the computer-labs.

For the VR-lab test we invited students to come to our presentation. We showed all of them the presentation at the same time. They got to look at one picture at a time, with some panning and

zooming in the start, which was done by the system administrator. Every picture was showed approximately 5 minutes. During this time they answered the questions on the paper, we kept the picture showing until everyone was finished. During the whole test we were available to answer questions, which there were none of.



Fig 8: Pictures showing the VR-lab test

The procedure for the test in the computer lab was somewhat different. It was done in three different computer-labs at the same time. There was one folder for the test placed on the server available on all the computers. In this folder there were four more folders, each one with the number of the picture inside. Because the test was individual and they had one computer each, they could decide

themselves how long they needed per picture for themselves. There were possibilities to ask questions before the test started, and briefly during it, when one of us popped in to each lab. There were no questions about the technicalities of the test.

The order in which the photos were arranged and shown was; high diversity, low diversity, middle diversity, and the alternative low diversity environment in the end.

All forms, for both tests, were to be marked with gender, age and name, or a mark. The test was anonymous. The name or marks they were asked to put on their forms was there to make us able to coordinate all the answers from the same person.

After the tests, we have collected and arranged the results for each separate person, and each separate picture, for both tests individually. In this way we can both compare the different results given by one individual or compare the results from all for one specific picture.

The test forms were then inserted into a Microsoft office excel form, getting average test score on each question, divided between the VR test and the test on the computer labs, gender and age. The data was then imported into the statistics program SPSS and later a program called STATISTICA for the final analyzes.

Hvordan ville du kjent deg om du hadde vært i dette miljøet i en time?
Markér svarene dine med ett kryss per rad.

- | | | | |
|--|--|--|--|
| <input type="checkbox"/> veldig sliten | <input type="checkbox"/> ganske sliten | <input type="checkbox"/> ganske uthvilt | <input type="checkbox"/> veldig uthvilt |
| <input type="checkbox"/> veldig trygg | <input type="checkbox"/> ganske trygg | <input type="checkbox"/> ganske engstelig | <input type="checkbox"/> veldig engstelig |
| <input type="checkbox"/> veldig uinteressert | <input type="checkbox"/> ganske uinteressert | <input type="checkbox"/> ganske interessert | <input type="checkbox"/> veldig interessert |
| <input type="checkbox"/> veldig selvsikker | <input type="checkbox"/> ganske selvsikker | <input type="checkbox"/> ganske ubesluttosom | <input type="checkbox"/> veldig ubesluttosom |
| <input type="checkbox"/> veldig pigg | <input type="checkbox"/> ganske pigg | <input type="checkbox"/> ganske døs | <input type="checkbox"/> veldig døs |
| <input type="checkbox"/> veldig sint | <input type="checkbox"/> ganske sint | <input type="checkbox"/> ganske vennlig | <input type="checkbox"/> veldig vennlig |
| <input type="checkbox"/> veldig effektiv | <input type="checkbox"/> ganske effektiv | <input type="checkbox"/> ganske uforetaksom | <input type="checkbox"/> veldig uforetaksom |
| <input type="checkbox"/> veldig avhengig | <input type="checkbox"/> ganske avhengig | <input type="checkbox"/> ganske selvstendig | <input type="checkbox"/> veldig selvstendig |
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This is the test-form we used for our tests in both VR and computer lab.

Result

Pre-data processing

For each forest type, an index of all the ratings on the adjectives was computed for each test participant. This emotional index for every forest and every participant was used as the bases for the analyses.

Analyses

To analyse the effects of both the different screens and the different forest diversity conditions a Repeated Measures ANOVA was used, with diversity as the within subjects factor and the screen as the between subjects factor.

Data file for Repeated Measures ANOVA

Cases (rows): respondents (21 large screens + 21 small screens).

R1 – Diversity/forest type, HD- high diversity, MD- middle diversity, LDG- low diversity, LDB- low diversity alternative.

Variables: Screen – 1-large, 2-small Mean – emotional index

Significance level was set to 0.05. This means that the P-value should not be over this level. If so, the result would not be statistically significant.

Repeated Measures Analysis of Variance (emoindex variant) Sigma-restricted parameterization Effective hypothesis decomposition					
Effect	SS	Degr. of Freedom	MS	F	p
Intercept	1442,810	1	1442,810	3879,912	0,000000
screen	0,048	1	0,048	0,128	0,721879
Error	14,875	40	0,372		
R1	14,318	3	4,773	25,844	0,000000
R1*screen	0,761	3	0,254	1,374	0,253939
Error	22,160	120	0,185		

Fig 9: Summary of ANOVA results

In the above summary of the ANOVA results we see that the main effect, the screen condition, did not have a significant effect on the responses (second row of the table). This tells us that the screen size and type did not have any impact on the participant's response. However, the different level of diversity (R1) was significant. This tells us that the degree of diversity affects the emotional response.

The interaction effect of diversity and screen was not statistically significant. It can be interesting anyway to look a bit further on this interaction graphically for each of the diversities.

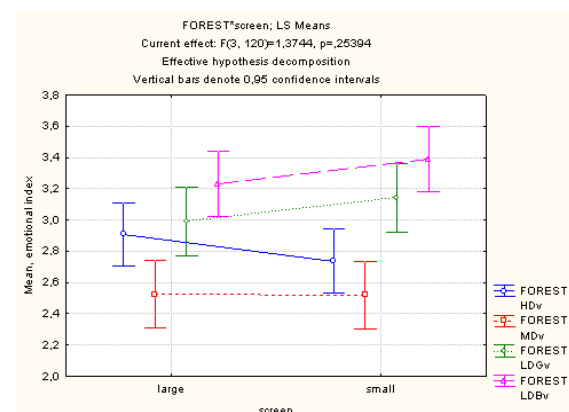


Fig 10: Above we see that the pattern is different for the different forests.

The high diversity forest had a higher mean in the large screen condition than in the small screen condition. The middle diversity forest had the same mean for both conditions. The low diversity forests however had a higher mean in the small screen condition.

This is interesting since it means that the responses to the high and low biodiversity conditions are affected in opposite ways by the different screens. The middle diversity forest is not affected at all by the viewing condition.

R1*screen; Unweighted Means (emoindex variant)							
Current effect: F(3, 120)=1,3744, p=.25394							
Effective hypothesis decomposition							
Cell No.	screen	R1	DV_1 Mean	DV_1 Std.Err.	DV_1 -95,00%	DV_1 +95,00%	N
1	1	HDv	2,908730	0,100362	2,705890	3,111570	21
2	1	MDv	2,523810	0,107124	2,307303	2,740316	21
3	1	LDGv	2,992063	0,108581	2,772613	3,211514	21
4	1	LDBv	3,230159	0,103688	3,020597	3,439721	21
5	2	HDv	2,738095	0,100362	2,535255	2,940935	21
6	2	MDv	2,519841	0,107124	2,303335	2,736348	21
7	2	LDGv	3,142857	0,108581	2,923407	3,362307	21
8	2	LDBv	3,388889	0,103688	3,179327	3,598451	21

Fig 11: Table of the means that is in the figure 10 above.

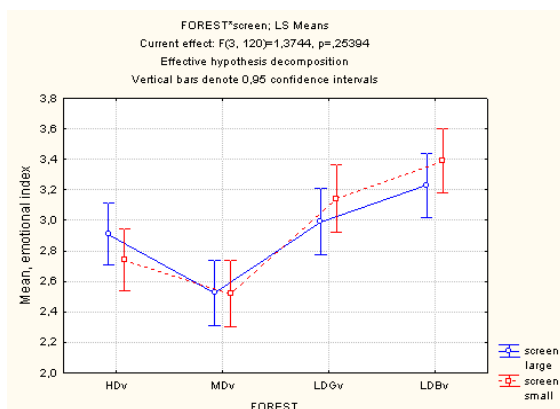


Fig 12: Shows a different way to illustrate, with the screens as the line and the diversity on the x-axis.

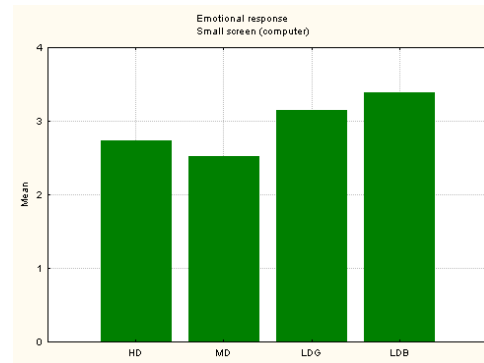


Fig 13: This is a bar plot of the means of the emotional index for the different forests in our study.

We have also compared our small screen test with the test in Lund on a similar screen. Our results are shown in fig 13, and the ones from Lund in fig 14.

In the Lund study, where people looked at forests in summer condition shown on a small screen, the mean emotional index looked like below: (Picture from Maria Johanssons powerpoint presentation at the IAPS conference in Rome July 2008)

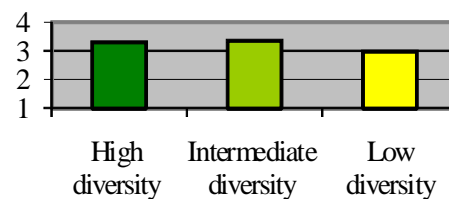


Fig 14. Shows the result from the screen-test done in Lund, Sweden (picture by Maria Johansson, Lund University, presented at the IAPS conference in Rome, July 2008)

Quite apparent the results show opposite trends. In our study the mid diversity environment has the lowest index mean. In Lund however the mid diversity has the highest mean of the three

conditions. Also in our study the low diversity forests had the highest mean while in the Lund study the low diversity had the lowest mean.

Our experience of the test

It was quite surprising to see how the outcome became. We suspected that there would be a bigger difference between the two screens. The interaction effect of diversity and screen was not significant, but there is still some interesting effect that appears between the screens. The high diversity forest had a higher mean on the VR screen. The middle diversity forest had no difference between the two screens, but the two low diversity forests had a higher mean on the small screen than on the big screen. This is quite interesting because the impression of the high and low diversity forests seems to be affected by the screen condition.

Why this happens is difficult to give a straight answer for, but we may think that there is something with the environments that may cause this. The degree of openness, groundcover and sunlight may be some factors that can affect this. Positive and negative details may also be more visible on the VR screen. Those details would be more apparent on the large screen and therefore could influence the result of the test.

There are great difference between the high diversity forest and the lower ones. In the HDf

there is much denser vegetation, and because of this there is an absence of sunlight. The condition in the LDf is quite different. Here there is almost no ground vegetation, and the sunlight is very strong in these photos.

We think that the reason for the high diversity forest to get a higher response on the bigger screen is the level of details. We think that these details tend to be more “blurring” on a smaller screen, and therefore do not give the viewer a good impression of this type of forest. Contrarily, in the LDf, the level of details is low. This can make the photos less exiting in the larger screen as you can see everything at once. However, in the smaller screen view condition this openness is not that visible, and therefore the image may appear as more exiting on the smaller screen. The MDf is right in between these levels. The level of details is neither high nor low. We think that this may be the reason for that there are no differences between the screen results for the MDf.

Another interesting aspect is to see how our small screen test differs from the test done in Lund, Sweden. According to our diagrams, low diversity forests had the highest mean, but in Sweden it had the lowest mean. We can wonder why this happens. Our photos are taken in another season (autumn) than the images taken in Sweden (summer). This would give another impression of the site, and therefore give another emotional index mean. Other factors like sunlight, could also explain the result. Our low diversity photo has a

very mystique impression with the sunlight coming in between the trees. This makes the images more exiting. Even though we wanted to make the photos as alike as possible, the sunlight is most visible in the lower diversity forests.

Another aspect for this result is the audience that was used in both tests. In our study the participants contained only young people, students. While in Sweden the audience contained a more mixed age group. This age difference and perhaps the difference in interest in forests may be another reason for the difference in the results.

There is also the possibility of a cultural difference between Norwegians and Swedes, even though we are quite close in many aspects. We have to acknowledge the possibility for different preferences in forests environments.

Discussion

When we first started with this experiment we had many thoughts of how this could be done. We had, in an earlier stage, been observing the possibilities for usage of the VR-lab. We have seen it in action when greater landscape models were shown in 3D. In our case we used 2D static images. This was both new and exciting for all of us.

We had great plans of using the VR-lab to the limit of its possibilities. We could add sound and even smell. We also thought about taking the photo and divide it up, making it more three dimensional. But we did none of this. The reason for that is

because the difference between the two screens would be too great, and because we would get too many unsecure factors that could affect the result. Our goal was that we wanted to investigate the difference in use of the VR-lab and the smaller computer screen. If we had added smell and sound, we would add elements that would make the result unclear.

As a result of this, we used only the 2D photo at the VR screen, as explained in the method. This actually worked just fine. We were surprised over how the photos changed. They got more depth in them. Another nice detail with it is that we were able to move in and out, side to side in the image. In the experiment done in Sweden they used zoomed pictures, a kind of a video. The problem with this illustration is that the moving only happens forward, therefore it is more artificial. In the use of the VR-lab this movement happens more natural and you can turn whatever way you want while showing it.

For future work with 2D images in the VR-lab it would be interesting to work with the images making them more 3D - like. For example it can be possible to use some techniques and programs to give a greater depth view and immersion of the areas we want to test. That could result in greater impression of the 3D landscape instead of a "flat" image. We always see the world as a three-dimensional image. To show a picture in 2D from the same site would give another impression. A technique to come closer to a 3D image would be

better for giving a more realistic illustration. But how large the effect would be is difficult to say. The mind interprets the image anyhow and maybe

does just as good a job to imagine the real life situation as a program which gives a better view of depth.

Acknowledgments

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References

- Johansson M and Laike T.** Intention to Respond to Local Wind Turbines: The Role of Attitudes and Visual Perception. 2007
- Küller R.**, Environmental assessments from a neuropsychological perspective. In environment, Cognition and Action: An integrated approach. Gärling T, Evans GW (eds.). Oxford University Press: New York, 1991; 111-147.
- Küller R.**, Emotional model of human-environment interaction. In Evaluation in Progress-Strategies for Environmental Research and Implementation. Abstracts of the 18th IAPS Conference [CD-ROM]. Martens B, Keul AG (eds.). Vienna University of Technology: Vienna 2004
- Karjalainen E and Tyrväinen L.** Visualisation in forest landscape preference research: A Finnish perspective. University of Helsinki Finland, 2001.
- Daniel T. C and Meitner M. M.** Representational validity of landscape visualisations: The effects of graphical realism on perceived scenic beauty of forest vistas. University of Arizona USA, 2001
- Johansson M, Gyllin M, Witzell J and Küller M.** Biological diversity, attitudes, and brain waves. Lund Institute of Technology, Sweden, Swedish University of Agricultural Sciences, Sweden and Swedish Forest Agency, Sweden, 2006.
- Orland B, Budthimedhee K and Uusitalo J.** Considering virtual world as representations of landscape realities and as tools for landscape planning, USA, 2001