Problem and Goal

In this study we decided to analyse, from a perceptive and cognitive point of view, how such new media affects the communication process and if it really provides a deeper level of consciousness of the architectonic idea.

In order to have a comparison during our test between the real space and the “virtual” one, it was decided to use an existing building. Our purpose was, starting from a 3D model, to render a certain number of points of view using different techniques: hideline, shading, rendering, photo-retouched rendering. Then, with the help of a perceptive test, to analyse differences in the level of comprehension of both images and the real building.

Therefore a 3D model of the public library in Malmö, Sweden (arch. Henning Larsen, Copenhagen), was made using ArchiCAD 5.0. It was reproduced in great detail including furniture and lighting equipment.

Thus several computer images were used to compare results from different techniques: the most meaningful and effective were selected paying attention to illumination parameters and rejecting those images appearing too synthetic.

Images both of the interior and exterior environment were rendered. Finally a set of 10 points of view (3 from the outside, 8 from the inside of the building) was chosen and for each view 4 images were prepared using different techniques: hideline, shading, rendering, photo-retouched rendering made with...
Adobe Photoshop (see Figures 1 to 4: an example of a point of view). At the end 40 computer images, 32 from the inside and 8 from the outside.

Then we had to face a problem: how could we measure the level of comprehension of those images?

In fact perceptive order is not a simple rational and numerical problem and perception is not a picture of the outer world, it is the result of a selective mental process of organisation that involves the whole structure of the object. Moreover, perception of a building or of a town is different from perception of any other work of art, like, for instance, a painting or a sculpture, because of the size that often makes it impossible to see in a unique sight.

Until some years ago, it was impossible to quantify the degree of comprehension of representations of a building. Now it is scientifically proved that the way man understands space is connected both to the physical act of seeing and to his own experiences and cultural background, but it is very difficult to find out the way these experiences interfere with perception of architecture.

During these last years some researches have been investigating the matter, in order to achieve a method, which allowed to “measure” the level of perception of the environment and to compare it with the comprehension of representation of it. During 1980 researchers at Lund University tried to find a way to quantify the level of perception of an image of an architectonic environment, measuring different degrees of comprehension achievable with several methods of representations (plans, schematic model, pictures, perspectives, colour slides or movie from eye level in a naturalistic model). It was found out that traditional graphic techniques were completely ineffective and led to misunderstandings.

As soon as you want to start a study concerning the measurement of human perception of the environment, a number of problems come to the surface: the problem of finding a method reliable enough to allow a correct measure of feelings, scientifically developed and as general as possible.

In our work we decided to adopt the SMB
(Semantisk Miljö Beskivning) perceptive test, developed at the Environmental Psychology Department of the School of Architecture in Lund, Sweden, largely used and tested to evaluate slides and pictures, never tested with digital images as in our study.

The starting point of the SMB test was the presupposition that the degree of comprehension can be evaluated with the use of some simple variables. The field of action was narrowed looking for a limited but reasonable, reliable and effective number of parameters or semantic variables. It would have been possible to have a measurement of the perception evaluating these variables.

The results were obtained using the factor analysis method that allows to group factors reflecting similar aspects of the same perceptive phenomenon. Eight different and reciprocally independent factors were found: pleasantness, complexity, unity, enclosedness, potency, social status, affection, and originality. Each of them corresponded to a group of adjectives and they were named according to the common meaning of all variables included inside the factor. The use of factor analysis conferred a scientific and standardised approach to the method.

**Method**

In this study people were asked to evaluate the real building in Malmö and the computer images in Lund, expressing quality assessments through rating scales (from little to much) with seven steps on the scale.

The analysis was thus divided in five categories:

- The real environment
- Ten images made with the Photoretouched rendering technique
- Ten images made with the Rendering
- Ten images made with the Shading technique
- Ten images made with the Hideline technique

As agreed with the staff at the Environmental Psychology unit, in order to obtain stable and statistically valid results, we interviewed at least twenty persons for each environment, divided in interior and exterior views, and for each category. The total number of persons involved was 225, 88 women and 137 men, grouped as follow:

- Real environment: 63 (30 interior, 33 exterior)
- Photoretouched images: 41 (21 interior, 20 exterior)
- Rendered images: 41 (21 interior, 20 exterior)
- Shaded images: 40 (20 interior, 20 exterior)
- Hiddenline images: 40 (20 interior, 20 exterior)

To avoid cultural differences which might have affected the stability of the results it was decided to interview similar groups of people both in situ (Malmö) and for the digital images in Lund. Our sample was made of students excluding those from the Architecture school because of their cultural background. In fact they might have evaluated the images and the real building using their knowledge after years of architectural studies, and therefore not having been a representative sample of potential clients.

**Test: the real building**

The test of the real building was carried out in order to have the most stable result to use it as benchmark. Therefore, in Malmö, we interviewed as many people as possible.

Generally speaking the persons involved were very precise and careful in the way they filled in the questionnaires. Only two test-forms out of 65 were excluded from the analysis because not completed. Generally, the time necessary to fill in the entire test form was three to four minutes.

Since the consciousness might have been influenced by the previous knowledge of the building, people were also asked to think of how often they had been in the library (first time, seldom, often) to understand if the main part of the persons involved
had already established a psychological relationship with the building. The answer was:

73% often
25% seldom
2% first time

Thus the main part of the persons involved were frequent visitors of the library. It probably means that the sample had already formed a clear concept of the building but we have not further studied how this parameter affects the result.

Test: the digital images

The test of the digital images was carried on placing a computer in a cafeteria at Lund University thus taking advantage of the flow of people during lunchtime.

Two days were necessary to reach the minimum number of tests. The images to be tested were presented editing 10 slideshows using Macromedia Director, one for each group of images (real environment and hideline, shaded, rendered, photoretouched images) dividing them in interior and exterior views. Each student was allowed to see (and to assess) only one slideshow.

Each image, placed on a neutral grey background, was showed for eight seconds plus one second of fading to pass to the next one using a 17" Sony Trinitron screen.

People were asked to look carefully at all the images before starting to fill in the test, in order to have the time to understand the building. Then the slideshow was left looping also while people were filling in the questionnaires, thus giving them the possibility to see the images before answering all the questions. The average of time spent to look at the images and to fill in all the questionnaires was 4 minutes.

We excluded people who had already been in the real building. This decision was taken to avoid that people might have been influenced in their assessments by the sensations felt in the real environment.

It is interesting to underline the test persons’ surprising receptiveness and favourable disposition toward the digital images and above all it was noticed a particular involvement for the photoretouched rendering and rendering categories.

Final Results: interior views

Comparing the results it was found out that all the computer visualisation techniques taken into consideration were very close to how the real building in Malmö was perceived. In fact, a significant difference between categories is usually found if the values differ from each other by at least 1 step unit. Looking at the resumptive graph (Figure 5), where Field is the real building, it can be noticed that all the categories differ from the real environment for less then one unit.

Therefore all these techniques can be considered good, and in some cases, very good, for the visualisation of architectural spaces.

In the analysis of the results we also took in consideration the Significance levels. It indicates how a large part of the variation might have occurred by pure chance. A significant level of 0.001 indicates that the chance of the differences in the assessments, being the result of chance, is less than 1/1000. Here we accepted a statistical value of 0.05.

Only for one factor, the “unity”, the significance level is less than 0.05, exactly 0.0414. This means that the small differences between one digital presentation and the real interior were not statistically significant.

We also noticed that men and women assessed in the same way for all the factors except for Affection.

Analysing the graphs we are able to say that the most effective technique was the “A1” Photoretouched rendering, followed, in order, by “B1” Rendering, “C1” Shading and “D1” Hideline. Of course these results confirmed our expectations but something astonished us: we thought that more detailed images, with people and objects, might have been more
understandable than, as in the Hideline case, less detailed and black and white ones. But it was rather surprising to see how close values from different techniques were: the impression from a hiddenline image seemed to give almost the same perception as the real building.

**Final Results: Exterior views**

The results obtained with the exterior points of view were of more difficult reading (Figure 6). Probably it was due to the use of only two points of view of the same facade of the building. The choice of only two images, instead of the initial three ones, was owed to the difficulty in moving persons to the back side of the library.

Generally speaking also for the exterior views all the digital techniques are satisfactory.

The significance level (p) is less than 0.05 in three of the eight factors:

- Enclosedness, p=0.0001
- Social Status, p=0.0017
- Affection, p=0.0005

It is necessary to underline the Enclosedness case: the value reached is between 2.52 and 3.72 respectively for Field and Hiddenline technique, it means that they differ for more than one step unit. Also the significance level is very low, p=0.0001, therefore this result indicates a very significant deviation.

Also for the exterior views the assessments of men and women are concordant with the only exception of the Affection.

We would like to underline a not negligible factor in the perceptive test: the test in situ was carried on in climatic and environmental conditions different from those we recreated in the digital images. The test was developed during winter, during cloudy days and with reduced illumination. In the digital images, on the contrary, the level of illumination is high.
This difference might have led to a variation in the already positive assessments reinforcing the validity of the “digital” techniques taken into consideration.

Another reservation should be made concerning our subject sample: students. Assessments of other sample might vary more.

Questions to be answered

This test was made with a small population and cannot be stated as the “truth”, but it raises some interesting questions:

- what is really important to represent in a particular environment (e.g. Objects, human shapes etc.)?
- In a balance cost / time of computing, is it really worth to spend a long time preparing sophisticated and complex images?

Giuliana Ucelli (1), Giuseppe Conti (1) and Jonas af Klercker (2)
(1) DPCE dep., University of Palermo, Italy
gucelli@telegest.it
gconti@telegest.it
(2) Lund University, Sweden
Jonas.af_Klercker@caad.lth.se