THE VISUAL PERCEPTION AND HUMAN COGNITION OF URBAN ENVIRONMENTS USING SEMANTIC SCALES

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Abstract. The purpose of this study was to examine visual perception and human cognition on the use of 3D models to support the proper essential means of urban design presentations. The perception and comprehension of spatial volumes was examined between these 3D visualizations as a means of presentations for urban design. The Semantic Environmental Description Scale was used to investigate the effectiveness of both static 3D conventional scale models and 3D digital modelling. By using the Semantic Environmental Scale, we can find the attributes which affects the visual perception between the users of traditional scale models and the 3D digital models. A survey was conducted to measure how the respondents describe an urban environment. There were two groups of users: The first group was only allowed to analyse the scale model and the other group was given the 3D digital animation model. This methodology allows us to identify these main factors or attributes which describes the laypersons perception between these visualization techniques. In this way, a quantitative way of predicting the overall assessment from these factors can be obtained, thus predicting the success of a specific visualization method and thereby evaluating these main factors that condition it.

1. Introduction

The importance of 3D reconstruction of buildings, cities and urban landscapes is becoming more recognized and acknowledged (Horne 2004). Different forms of design media which have been developed ever since the renaissance period, are being used to scale models and perspectives drawings to facilitate the communication between designers and laymen (Mitchell and McCullough 1994). A visual survey in urban design is an examination of the form, appearance and composition of a city—an evaluation of its assets and liabilities. A physical visual survey enables the urban designer to see where the city needs reshaping (Spreiregen 2000). A physical visual survey enables the urban designer to see where the city needs reshaping (Spreiregen 2000). Scale models are experienced to be much more communicative, easy and fast to interpret in this sense, both by designers and clients.
Furthermore, during the course of design, scale models are seen to provide a strong form of penetration for the designer by illuminating all details of the building. At the same time, it is observed to hold more potential in offering several new design routes to be followed (Arpak 2008).

Urban design is an integral part of architecture which includes traditional drawings and other visual instruments which represented totality of the built environment. Traditional drawings, scale models and other forms or urban visualization representations are useful to the urban designer in their capacity to provide information on the details or particulars of urban space and form and to help substantiate important regulating systems (Bell et al. 2000). In the traditional urban design process, the designer creates different types of visual instruments for the stakeholders. It is during this process that this form of visual representation is vital. If the designer cannot provide the correct information of his intended design, then the communication between both parties are not as effective. Advocates of computer generated models will say that the physical three-dimensional model is now obsolete. The reality is that any form of computer design is only in a series of two-dimensional images on a screen or sheet. It is not as effective as a means of communicating concepts as the physical model, nor can it compete on the basis of speed and cost for many projects (Day 2002). The narrow focus of these traditional representations for urban design limits their broad applicability to the design task at the urban scale. These types of traditional representations remain invaluable to the urban designer in the work of reconstructing our urban space (Bell et al. 2000). Accuracy in architectural model making most certainly requires the use of tactile and physical materials. A scale model is meant to represent a precise, but smaller construction of the intended design. In architecture, the considerations are much more concerned with form and aesthetics, as well as function. Therefore, in many aspects of architectural model making, surface texture and color also play an important role (Day 2002). The future of urban visualization is guaranteed to see changes that will improve and enhance the quality of the visual presentation through virtual enhancements. As new software emerges the process in presenting architectural designs is rapidly changing. Companies are forgoing the traditional methods of architectural model making in order to apply the newest technology to their presentations. By using computer aided modeling functions the representation and fabrication methods of scaled models can be significantly enhanced. The evaluation of these types of models is vital in improving the tasks and functions of the innovative 3D visualization techniques (Koramaz 2009). The conceptual and computational changes will also set the departure of this new mode of design from the old. These models are built as an integral part of the design process and will naturally become the proving point for the urban designer. The constraints of space, accessibility and function of each element can be studied. The challenge is to find the factors users have in common in way of visual perception and human cognition. When these factors are known they can be used to increase the impression on the user. Thus, the difference between the medium (computer media) and reality is not only an obstacle but a variable that can be manipulated. In an attempt to develop a method for systematically measuring and describing perception of human environment, the total perception of man-made environment can be described in a limited number of meaningful dimensions. These can in themselves be defined and measured and they are valid within determinable limits (Küller 1972). This hypothesis was tested by letting groups of experimental subjects rate various environments with descriptive words, which were given the form of rating scales, i.e. semantic rating scales. Data was processed by means of factor analysis, through which eight main dimensions were obtained.
1.1. STATEMENT OF THE PROBLEM

According to Osgood, Suci, & Tannenbaum, the SMB attributes can be described in a limited number of meaningful dimensions (Osgood et al. 1957). Those dimensions can be separately defined and measured and they are valid within determinable limits. They proposed a semantic differential technique to analyse semantic structures and the affective meaning of things. Semantic differential technique has been successfully applied to find the semantic structure of designs, including the design of cars, doors, office chairs and so forth. The semantic environment description (SMB) was developed by Küller to evaluate the impression of an architectural environment.

Specifically, this research will seek to find the following:

a. Using the Semantic Environmental Scale, what are the specific factors to psychological design paradigms in the visual perception between these two visual methods?
b. What are the different relationship of human cognition and visual perception of these visual methods using the SMB Scale?
c. How does these two different methods of visualization affect the visual perception of users without architectural or design background?

1.2. OBJECTIVES

The aim of this study is to improve the tasks of three dimensional models as an active communication tool that is an integrated part of urban design. Because the experience with real and virtual situations of users varies, the emotions they feel when seeing the same 3D models will also differ. Subsequently, performance will vary, when what is desired is that the effect of the environment on the user will be predictable.

The purpose of this research is to find out the following:

a. To identify the specific factors to psychological design in the visual perception between these two visual methods using the Semantic Environmental Scale.
b. To identify the different relationship of human cognition and visual perception of these visual methods using the SMB Scale.
c. To investigate how does these two different methods of visualization affect the visual perception of users without architectural or design background.

1.3. SIGNIFICANCE OF THE STUDY

The main argument of this study builds around the generative and visual perceptive role of the architectural scale model and the 3D digital model in urban design. These results will therefore guide the urban designers most effective and instant way of completely communicating an urban design concept. The evaluation of these types of models is vital in improving the tasks and functions of the innovative 3D visualization techniques. The conceptual and computational changes will also set the departure of this new mode of design from the old.
2. Related Studies and Literature

There is a debate in the varying forms of urban representations used in urban design. Sketches, physical models and now, more recently, 3D digital models tend to be incompatible forms of representations. The contemporary designer is required assimilate these divergent media into a single mental construct and in so doing is distracted from the central process of design (Kanji 2002). The needs for 3D city models are growing and expanding rapidly in various fields include urban planning and design, architecture, environmental visualization and many more. The efficient generations of the 3D city models are improving the practice of urban environmental planning and design (Sadek et al. 2000). Urban planning is a complex process encompassing aspects of social, economic, physical and spatial significance. These aspects are not independent, interacting with each other within the urban system (Perraton 1978). Therefore, the decision-making process depends on a dialectic relation between them all. As such, communication among these various aspects is central to urban planning. The communication difficulties between planning authorities and designers as well as the deeper underlying problems of design policy deficiencies that eventually lead to uncertainty and lack of consistency (Hall 1996). This is an inevitable outcome of an informal, to a large extend, planning culture passed on by word of mouth rather than carefully and clearly established policies and frameworks. Furthermore, there is a lack of consistency on the levels of detail employed by planning authorities in presenting and documenting their policies and strategies to both professionals and the public. There is clearly a series of communication problems in this field and it has been advocated that computers can offer satisfactory solutions (Day et al. 1995; Hall 1996).

The number of studies concerning the investigation of users’ subjective responses for 3D visualization techniques in urban planning and architectural design processes has increased recently (Day 2002). Many of these investigation studies use Semantic Differential measurement scales which systematically describe the perceived environment (Bates Brkljac 2007; Westerdahl et al. 2006). In describing how users experience their environment, the first semantic measurement scale study that was produced by Osgood, Suci and Tannenbaum (1957) was titled, “The Measurement of Meaning”. Another study titled, “A semantic model for describing perceived environment”, was written by Küller (1972) and aimed to measure and describe the experiences of built environments systematically. Küller criticized Osgood, Suci and Tannenbaum’s study as being limited in measuring the perception of built environments. With the semantic environmental scale (SMB from Swedish means ‘‘semantisk miljö beskrivning’’), Küller also used the same procedure in methodology such as clustering subjective responses into dimensions. But in this study, the respondents were asked to describe not the context or terms but the images from real environments and living spaces. (Koramaz and Gulersoy 2009). In order to investigate the efficiency of 3D urban models, Osgood, Suci and Tannenbaum’s semantic differential scale was used mostly to compare these techniques with their functions such as, accuracy, realism and abstraction (Bates-Brkljac 2007). But Küller’s SMB scale represented the real environment (Westerdahl et al. 2006). Accordingly, the SMB scale can efficiently be used in either built environments or with representation tools and visualization techniques such as sketches, collages or three-dimensional models (Küller 1991). Thus, the SMB scale was chosen in this study to compare the responses of the different user’s between conventional scale models and 3D digital models with applications in urban design.
A study done by Koramaz and Gulersoy examined and compared the efficiency of two visualization techniques: the static 3D urban model and the VR application, which was developed for the case area known as the Zeyrek Urban Historic site. The examination in this study was conducted with the use of a questionnaire which compares the perceived communication and interaction levels between these techniques (Winkel 1998). The VR application was reported to have given a fairly better representation of users’ experiences regarding the sense of orientation, cognition of the urban historic site and a sense of spatial Enclosedness than the static 3D urban model (Koramaz and Gulersoy 2009). There are different methodological approaches to the problems of human responses to visual attributes of the environment. Cunningham et al. suggested that simulations would allow the urban designer to consider a range of different design options and determine which combinations of elements were most effective in meeting design options and determine which combinations of elements were most effective in meeting design objectives. It could then identify which design parameters seemed most crucial to user perceptions. According to Cunningham, this step is essential for a better understanding of how complex cues of any environment are coded and weighted by the perceiver (Winkel 1998). Cunningham et al. were concerned with the development of a technique which could be used in urban design problems to predict user responses to various design proposals. The focus of their research was the urban street. Using a combination of video tapes, photographs and movies, Cunningham and his colleagues have argued that responses to black and white video tapes of “real” streets are created by pasting photos of the actual streets on a “black face.” The response measures employed were a short Semantic Differential scale and a test measuring the amount of interest generated by the “trip” down the street. In this study, colour was an important cue since using colour movies resulted in greater expressed interest in the street. The authors concluded that it would be possible to make use of television or movies to stimulate proposed changes in urban street design (Winkel 1998).

3. Research Methods

3.1. RESEARCH METHODS DESCRIPTION

The research methodology required the gathering of relevant data from different levels. My proponents are different members of the local community with no architectural or design background, and making certain that they should be in the college level and at least 18 years old. The case study location is Cebu’s most well-known historic landmark: The Magellan’s Cross. It is located beside the Basilica Minore del Sto. Niño in front of the Cebu City Hall. A physical scale model was created, using conventional materials made up of different types of paper and cardboard. Additionally, a 3D digital model of the same site was created using Google Sketchup. These surveys were compiled in databases and analysed to arrive at a more complete understanding of the most preferred visualization tool for urban planning. The authors worked with the students, faculty and staff of the University of San Carlos College of Architecture and Fine Arts as well as with the other colleges from the other USC department to identify potential participants. Some of Cebu’s prominent local urban planners also gave suggestions over the course of the experiment to provide a more detailed and better perspective of the urban planning practice: Their experiences, reactions, beliefs, and ideas about the role of these visualization techniques in the urban planning practice.
3.2. RESEARCH SAMPLING DESIGN

In order for a study to be scientifically valid, the range and proper use of sampling methods that yield unbiased estimates of behavior are critical. Non-probability sampling is a sampling method where an individual’s chance of being included in the sample is unknown or unequal (Austin and Pinkleton 1974). Due to several factors like time constraints and limited financial resources, I used the Incidental Sampling Method, which is applied to those samples which are taken because they are the most available (Guilford and Fruchter 1973). This is a type of non-probability sampling which involves the sample being drawn from that part of the population which is close to hand. That is, a sample population selected because it is readily available.

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Adjectives</th>
</tr>
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</table>
| pleasantness   | 1. boring – langmoedig – saai  
2. brutal – lelijk – graaf  
3. good – gut – goed, gunstig  
4. hygienic – hygiënisch – schoon  
5. pleasant – genotuek – aangenaam  
6. secure – geborgen – veilig, geborgen  
7. stimulating – energetisch – stimulerend, opwondend  
8. ugly – hiatisch – lelijk |
| complexity     | 1. composite – samenhangend – samengezet (uit onderdelen)  
2. lively – levensvol – levendig  
3. motley – kunt – bonte kleuren, kleurrijk  
4. subdivided – gewrongen – gecentraliseerd, gemengd (op kleur) |
| unity          | 1. consistent – consequent – consequent  
2. functional – functioneel – funktionell  
3. of pure style – streng – stijlzuiver  
4. whole – eenheid – volledig, eenheid vormend |
| introversion   | 1. shy – ligt – licht  
2. closed – gesloten – gesloten  
3. demarcated – abgegrenzt – afgekapt, beperkt  
4. open – offen – open |
| potency        | 1. feminine – weiblich – vrouwelijk  
2. fragile – empfindlich – kweekbaar  
3. masculine – mannelijk – mannelijk  
4. potent – krachtig – kräftig |
| social status  | 1. expensive – kostbaar – kostbaar  
2. lavish – uitvoerig – overzadig  
3. simple – eenvoudig – eenvoudig  
4. well-polished – aardig – goed onderhouden |
| affection      | 1. aged – getijnd – oud, vanouds  
2. modern – modern – modern  
3. new – nieuw – nieuw  
4. timeworn – grotend – lelijk |
| originality    | 1. curious – eigenzinnig – bijzonder  
2. ordinary – gewone – gewone  
3. special – speciaal – spezifisch  
4. surprising – onverwacht – verrassend |

Figure 1: The adjective phrases for the SMB Scale (Küller 1972)

3.3. RESEARCH INSTRUMENTS

Data collection consisted of a set of questionnaire. One set for the scale models and another set for the 3D animation. This survey instrument was used to measure the eight (8) variables of Küller’s Semantic Environmental Scale. I was able to get sixty (60) participants for the scale model group and another sixty (60) for the 3D animation group, for a total of one hundred and twenty (120) participants. These participants embody a range of different positions, educational backgrounds and who come from different schools, institutions and communities. Using the adjective phrases given by Küller, I created a Survey Instrument.
Selecting the simplest adjective for this survey is important as not to confuse the participants. The adjectives chosen for this survey are:

<table>
<thead>
<tr>
<th>Table 1: Adjectives chosen for the SMB as analyzed by Küller</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Pleasantness Factor: (Desirable Perception)</td>
</tr>
<tr>
<td>• Boring-Exciting</td>
</tr>
<tr>
<td>• Hideous-Beautiful</td>
</tr>
<tr>
<td>2. Complexity Factor: (Desirable Perception)</td>
</tr>
<tr>
<td>• Gloomy-Brilliant</td>
</tr>
<tr>
<td>3. Unity Factor: (Desirable)</td>
</tr>
<tr>
<td>• Chaotic-Orderly</td>
</tr>
<tr>
<td>• Useless-Useful</td>
</tr>
<tr>
<td>4. Enclosedness Factor: (Human Cognition)</td>
</tr>
<tr>
<td>• Dark-Light</td>
</tr>
<tr>
<td>• Open-Closed</td>
</tr>
<tr>
<td>5. Potency Factor: (Human Cognition)</td>
</tr>
<tr>
<td>• Femininity-Masculinity</td>
</tr>
<tr>
<td>• Rough-Gentle</td>
</tr>
<tr>
<td>6. Social Status Factor: (Desirable Perception)</td>
</tr>
<tr>
<td>• Simple-Lavish</td>
</tr>
<tr>
<td>• Cheap-Expensive</td>
</tr>
<tr>
<td>7. Affection Factor: (Human Cognition)</td>
</tr>
<tr>
<td>• Ancient-Modern</td>
</tr>
<tr>
<td>• Timeless-New</td>
</tr>
<tr>
<td>8. Originality Factor: (Human Cognition)</td>
</tr>
<tr>
<td>• Ordinary-Unique</td>
</tr>
<tr>
<td>• Rare-Common</td>
</tr>
</tbody>
</table>

3.4. RESEARCH RESPONDENTS

The test was administered to different educational levels:

1. Respondents with no architectural or design background,
2. At least 18 years old and of college level and/or
3. Professionals in various fields.

Around sixty (60) participants for the scale model group and another sixty (60) for the 3D animation group, for a total of one hundred and twenty (120) participants.
3.5. RESEARCH ADMINISTRATIVE PROCEDURES

Before administering the questionnaire, the authors would like to explain the purpose of the study and the test structure. First, the participants completed some basic personal background questions. Next, I distributed the survey papers and asked the participants to study the urban model. The participants will then be allotted a specific amount of time to answer the questionnaires. These surveys are then collected after the period was over (figure 2).

![Figure 2: Methodology: The Research Data Flow](image)

3.6. RESEARCH DATA FLOW

4. Research Data Presentation and Analysis

4.1. DATA PROCESSING

From the data base of answers, the following data analysis was applied:
   a.) Identifying the SMB Factors:
The SMB Factor variables by Küller are being used in this research. Each factor, according to Küller is capable of describing built environments. These factors are chosen to compare the responses of the different users.

b.) Ranking of the SMB Factors:

The SMB Factors explain the perceived differences between Scale and 3D Digital models. The overall assessment of each factor may be different. This relation can then be quantified by means of a statistical relationship, for example a correlation coefficient. Using Spearman’s Correlation Coefficient this was used to measure the influence between each factor and then a ranking was made according to these criteria.

In figure 3, the Scale Models are perceived to be high in the quality of being pleasant, beautiful and secure. The degree of variation or more specifically, intensity, contrast and abundance is also slightly higher.

Figure 3: Scale Model Correlations

In figure 4, the 3D Digital Models are perceived to be high in the quality of recognition, giving rise to a sense of familiarity often related to the age of the environment. The degree of variation or more specifically, intensity, contrast and abundance is also slightly higher.
c.) Comparative Analysis

A comparative analysis was created to compare the eight (8) factors between the Scale and 3D Digital Model. Statistical analysis was made by using the statistical software package SPSS 17.0©. The results are according to responses from the respondents having been examined in two parts. The format of the questionnaire for the Scale Model and 3D Digital Model are the same. Variables related to perception level of the characteristics of the urban site, were factor analyzed in order to group the different variables into components. Responses from separate groups, the Scale Model group and the 3D Digital Model group, were compared with T-test to examine the equality of means.

Spatial dimensions color and the number of people may influence the impression of Pleasantness. The environment quality of being pleasant, satisfying, amusing, beautiful and secure is rated higher for the 3D Animation group.

Affection is related to combination of elements or to characteristics of the viewer. The quality of recognition, fondness and warmth giving rise to a sense of familiarity often related to the age of the built environment is rated higher for the 3D Animation group.

The 3D Animation group rated the experience of Complexity higher compared to the Scale Model group. Complexity is related to the number of components in the built environment and to the placement and intensity of the components, such as color strength and contrast, furniture, light sources, patterns, auditive components and the number of people present all influence complexity.
The experience of harmony, described in the factor Unity, rests mainly on Gestalt principles of perceptual organization like similarity, proximity, continuation and closure of the built environment. These apply to the elements of the scale model itself and to the buildings, façade, as well as shape and color of the entire 3D model. Interestingly, when the number of different colors or the intensity of colors increase, the degree of unity decreases. The factor of Unity is higher for the 3D Animation group but there is no significant difference between the two types of visualization.

The sense of Enclosedness is higher for the 3D Animation group which is determined by the shape and size of a built environment and the experience of focal point. Light colors, a certain amount of well suited furnishing, and the diffused lighting decrease the impression of enclosure. Besides these visual characteristics, Küller also mentioned auditive characteristics such as echo duration. Although the factor of Enclosedness is higher for the 3D Animation group there is also no significant difference between the two types of visualization.

The size, mass, coarse materials, rough surfaces and dark colors contribute to the impression of Potency. Potency is also attributed to being “effectiveness” or the “usefulness” of the built environment. Although the factor of Potency is higher for the Scale Model group there is also no significant difference between the two types of visualization.

The 3D Animation group rated Social Status higher than the Scale Model group, which is an expression of the built environment in socio economic terms, but also in terms of maintenance, preservation and protection. Choice of materials and color scheme also influence this dimension. The 3D Animation group rated the factor Originality higher than the Scale Model group, which is related to combination of elements or to characteristics of the viewer. Originality is also meant as the extraordinary, unusual, surprising, and unforeseen in the built environment. To establish the difference between these two methods, T-test was utilized to determine the significant difference between two groups. The results tell that of the eight (8) SMB Factors, only five variables (Pleasantness, Affection, Complexity, Social Status, and Originality) showed significant results in favour of the 3D Digital Animation (table 2 and figure 5). The two group’s perception in terms of Unity, Enclosedness, and Potency did not show any significant difference. When the overall semantic mean scores of the two groups were compared, a significant result was found [\( F(120, 1) = 13.2, p = .000 \)] an indication that the 3D Digital Animation group perceived the architectural design more desirably compared to the scale model group.
5. Summary of the results of the study

This research has attempted to study and analyze the observer’s response to urban scale models. Particularly, it attempts to find the answers to the three questions raised in the Introduction.

First, there is a possibility of defining a set of specific factors which affects the user’s psychological and visual perception using the SMB Scale. The experiments were carried out with half the test subjects using the traditional Scale Model and half using the 3D Digital Animation. As Küller stated, the total perception of architectural urban environment can be described in a limited number of meaningful dimensions: Pleasantness, Affection, Complexity, Unity, Enclosedness, Potency, Social Status and Originality. These dimensions can be separately defined and measured and they are valid within determinable limits.

Second, this research tried to study if it is possible to identify the human cognition and perceptions which determine the overall correlations between each of the SMB Factors. In Table 2, the highest correlation for the Scale Models was between the factors of Affection and Pleasantness (34.9%) while at the other extreme, the lowest is between the factors of Unity and Social Status (.04%). In Table 4, the highest correlation for the 3D Digital Models was between the factors of Affection and Complexity (34%) while also at the other extreme, the lowest is between the factors of Unity and Potency (.01%).

Thirdly, the responses for the 3D Digital Animation were different from those for the static Scale Model in several factors of the SMB Scale. It means that 3D Digital Models increased the sense of pleasantness and a degree of variation even better than the traditional Scale Model. In terms of socio-economic terms, a sense of familiarity of the environment and originality, 3D Digital Models are also better than the traditional Scale Model. Using 3D Digital Models is a fairly better representation of users’ experiences regarding the sense of Visual Perception and Human Cognition of the urban site and a sense of spatial Enclosedness than the static traditional Scale model. Eventually a knowledge base could be developed on the appraisal of 3D models. Such a database system would suggest improvements or at least.
"good" variations to a feature that a 3D modeler has just created. In this way the creation of models for urban design or architectural walk-through, etc. would lead in the right direction. With this aid the complexity of creating a 3D computer world can be lowered or increased. It will eventually depend upon the designer which factors of the SMB scale he wishes to take advantage of. The creation of Scale Models would also be improved. It remains to be seen if and how human affective response and appraisal can be formalized in such a fashion. I believe that to some degree formalization will never be complete and that the unique learning and experience of the users of these two types of 3D models will always be a factor. Extraneous variables come into play when using these questionnaires, such as the test subject being aware that the focus is on certain objects, aspects or the amount of details in the model, their behavior, etc. It is best to not let the respondents know what the test is about, whether it focuses on how buildings or animations in a 3D model are perceived. Rather, the test subject should carry out a task that requires attention and in which details and overall awareness of an environment are both important. The SMB scale could be stated as a validated measurement scale for comparing users’ responses for the static Scale Model and the 3D Digital Animation. Overall, the results showed that the methodology was valuable in comparing the efficiency of visualization techniques in representing urban sites. It is logical to assume that effective qualities of a building can be transferred to a 3D Digital Model, it is not possible to say in general which of the dimensions of the SMB Scale suffer most by the loss of information and the display on the desktop monitor. This depends on the characteristics of the building, such as physical properties, style and function and the characteristics of its representation. It is highly probable that the dimensions in which sizes and distances play an important role especially Enclosedness, potency and Pleasantness are affected most, especially if measures for actual reference are absent. The dimensions in which the presence of many components is important will be influenced, because components such as people, decorations and furniture are often omitted from the model or represented unconvincingly.

5.1. RECOMMENDATIONS

Though these data support the positive use of Virtual 3D models as an effective means of visualization, many factors can affect the perception of the client when this type of visualization is used as an urban design tool. There is obviously some doubt if these results be applied to different types of people with different traditions and cultures. This does also not come into account if age and experience of the client has to do with the enhancement of the perception of the virtual 3D models and traditional scale models. We also do not know if these results apply to the general population. Results from Küber and studies by Koramaz and Gulersoy do indicate that there has been a positive effect and response in their research, but again, it comes down to identifying other critical factors involved. Koramaz and Gulersoy study states that VR application was reported to have given a fairly better representation of users’ experiences regarding the sense of orientation, cognition of the urban historic site and a sense of spatial Enclosedness than the static 3D urban model (Koramaz and Gulersoy 2009). Further research needs to be conducted to establish the cause and effect of the relationships between these types of visualization procedures. It is important to identify other key elements or attributes responsible for the client or the ordinary laymen’s perception of these different types of 3D environment. The influence of different factors such as sound,
temperature, gender, age, linguistic background as well as the different cultures and traditions of the laymen’s perception may generate significant results as a whole.

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