Real Scale versus Computer Generated: Comparing Models Ecological Validity

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Abstract

This research compares the Ecological Validity of Real Scale Models (RSM) and Computer Generated Models (CGM) as surrogates of a real space in studies of perception. The living area of a low-income housing project in Guatire, Venezuela was modeled in real scale and on a computer walk-through simulator. The real space and the models were evaluated using a the *Psychological Impressions Measuring Test* (La Scalea, 1991), consisting of a semantic differential formed by eleven pairs of opposing adjectives set on a scale of seven levels, that can be grouped in three factors (dimensional, social and affective). The results tend to indicate that both models are Ecologically Valid, however the general perception of the RSM is more similar to that of the Real Space then the CGM. The dimensional characteristics of the real space were well rendered by both models, with the CGM replicating better the Social dimension.

Introduction

Advances in electronic design and communication are already reshaping the way architecture is done. The development of more sophisticated and user-friendly Computer Aided Design (CAD) software and of cheaper and more powerful hardware is making computers more and more accessible to architects, planners and designers. These professionals are not only using them as a drafting tool but also as a instrument for visualization. Designers are building digital models of their designs and producing photo-like renderings of spaces that do not exist in the dimensional world.

The problem resides in how realistic these Computer Generated Models (CGM) are? Moss et al. [1] considered realism as "the capacity to reproduce as exactly as possible the object of study without actually using it". He considers that realism depends on:

- The number of elements that are reproduced;
- The quality of those elements;
- The similarity of replication;
- Replication of the situation.

CGM respond well to these considerations, they can be very realistic. But are they capable of reproducing the same impressions on people as a real space? Research has debated about the problems of the mode of representations and its influence on the judgment which is made. Wools [2], Lau [3] and Canter et al. [4] have demonstrated that the perception of a space is influenced by the mode of presentation. CGM are two-dimensional representations of three-dimensional space. Canter [4] considers the three-dimensionality of the stimuli as crucial for its perception. So, can a CGM afford as much as a three-dimensional model?

The Laboratorio de Experimentacíon Espacial (LEE) has been concerned with the problem of reality of the models used by architects. More specifically, with there Ecological Validity [5] which is the degree in which laboratory results can be taken as reliable and representative of a real situation. Recent research [6] has focused on the problem of the Ecological Validity of the Real Scale Model (RSM). The results found it to be ecologically valid as a representation of a real space.

Objectives and Method of Research

This research has two objectives:

- study the Ecological Validity of a Computer Generated Model and a Real Scale Model in representing a real space; and
- compare the results of the two models.

As means to examine these problems an experiment was carried out using a Real-Scale Model and a Computer Generated Model of a real space. The space (Fig. 1) chosen was the living area of the basic apartment of a low-income housing project in Guatire, Estado Miranda.

Fig. 1 Real space.

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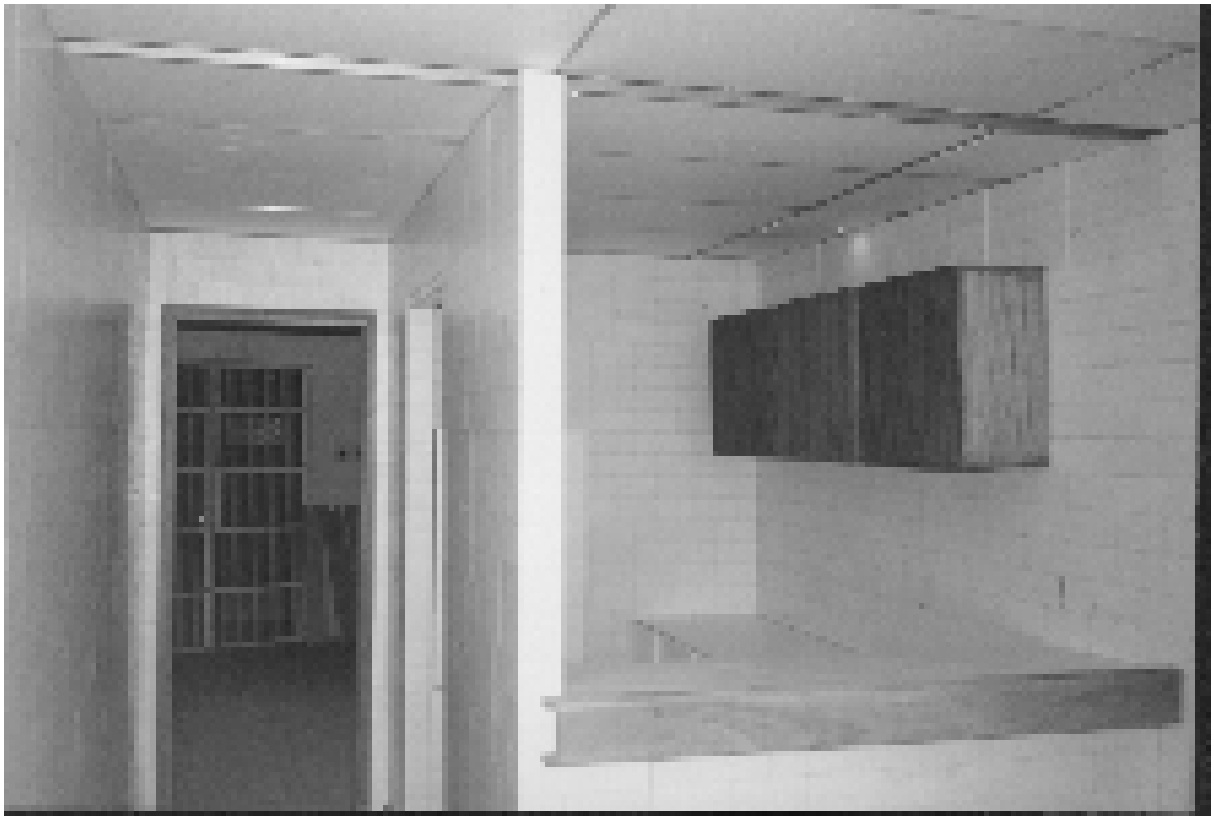


Fig. 2a-b The *Real Scale Model* was done using quick assembly plastic building bricks and mock-up furniture.

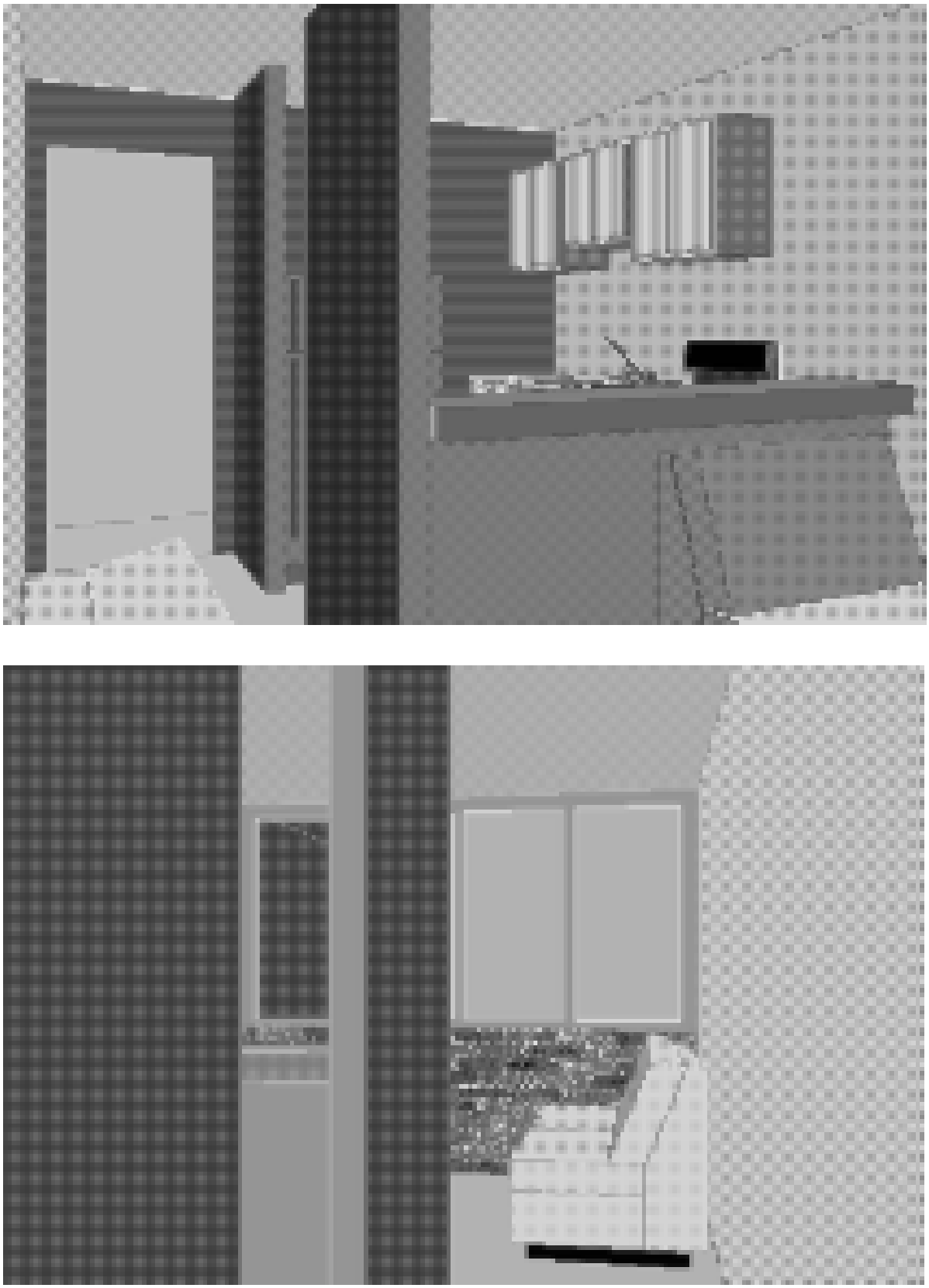


Fig. 3 The *Computer Generated Model* was realized using *Virtus Walkthrough*.

The real space and the two models of the space were evaluated using the Psychological Impressions Measuring Test (Fig. 4) developed by Luis La Scalea (1991). This test was designed to measure peoples psychological impressions produced by a space. It consists of a semantic differential formed by eleven pairs of opposing adjectives set on a scale of seven levels, that can be grouped in three factors:

- *Dimensional*: related to the form, size and pressure produced by the space;
- *Affective*: refers to emotions produced by the perception of the space;
- *Social*: related to values, beliefs and habits of subjects.

Open							Closed
Sad							Happy
Ordinary							Refined
Oppressive							Spacious
Pleasant							Unpleasant
Confusing							Clear
Elegant							Tasteless
Interesting							Boring
Oppressive							Spacious
Warm							Cold
Vulgar							Distinguished

Fig. 4 Psychological Impressions Measuring Test (IMIP).

From a basic population of randomly chosen senior students of the Faculty of Architecture of the Central University of Venezuela, three similar groups of 18 students were formed. Each group evaluated one of the models or the real space.

Results

The results of the evaluation of the Real Space were compared to those of the RSM and of the CGM using the Mann-Whitney U Test. This is a powerful non-parametric alternative to the test, that allows the researcher to examine if there is a significant difference between two independent samples. First, the results were related by pairs of adjectives and then they were grouped by factors. As a way to test the results, the estimated normal distribution of each sample grouped by factor was plotted and visually compared.

The results of the comparison by pairs of adjectives of the Real Space and the RSM (Table 1) showed no significant difference between all the adjectives

except one (sad/happy). On the other hand, the results of the real space and the GCM revealed that there are significant differences between almost half of the pairs of adjectives (sad/happy; oppressive/spacious; confusing/clear; interesting/boring and warm/cold) These results tend to indicate that the perception of the RSM is more similar to that of the real space than the perception of the CGM.

Pair of adjectives	PA1	PA2	PA3	PA4	PA5	PA6	PA7	PA8	PA9	PA10	PA11
U	92.5	32.5	61.0	54.5	79.0	107.0	68.5	61.5	89.0	104.5	81.5
Distributions probably different	NO	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO

Table 1 Results of U test between the Real Space and the Real Scale Model.

Pair of adjectives	PA1	PA2	PA3	PA4	PA5	PA6	PA7	PA8	PA9	PA10	PA11
U	75.5	48.5	66.0	47.5	66.5	38.0	76.0	25.0	75.0	78.0	65.5
Distributions probably different	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO

Table 2 Results of U test between the RSM and the CGM.

The second level of analysis grouped the results of the evaluations by factors (table 3 and 4). This reveals that the perception of the RSM is similar to that of the real space only on the dimensional factor while the CGM is perceived alike in two factors: the dimensional and the social.

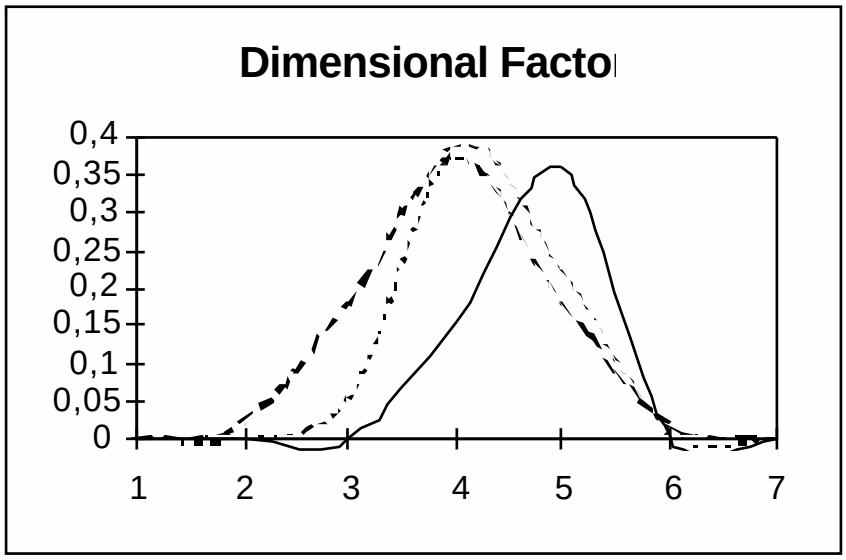
	Real Space/Real Scale		
	Dimensional	Affective	Social
U	68.5	41.0	50.5
Distributions probably different	NO	YES	YES

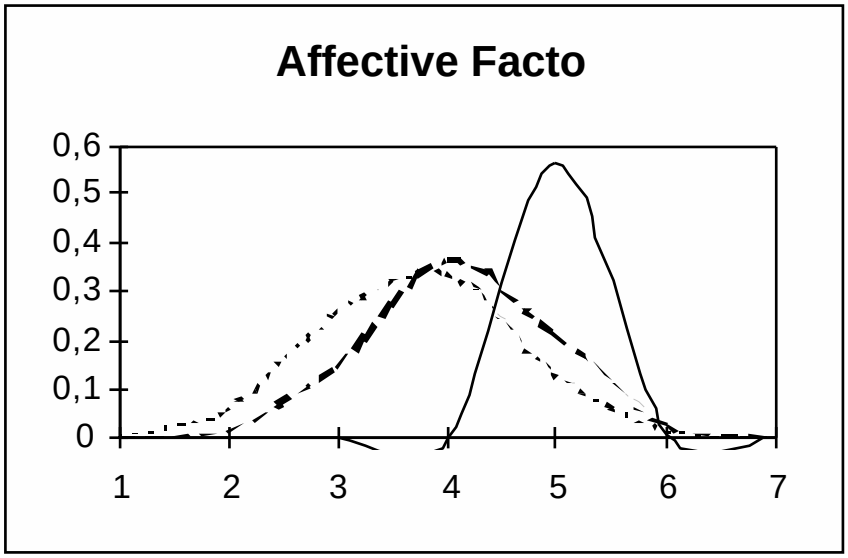
Table 3 Results of the U test between factors of the Real Space/Real Scale Model.

	Real Space/Computer Generated		
	Dimensional	Affective	Social
U	77.0	33.0	62.0
Distributions probably different	NO	YES	NO

Table 4 Results of the U test between factors of the RSM/CGM.

A final test was done by plotting the estimated normal distribution of the evaluations grouped by factors (fig. 4). The visual analysis of the graphics reveal that the curves produced by the models were similar but they do not match the one formed by the real space. This supposes that neither models reproduces exactly the evaluation of the real space. But, closer scrutiny shows that the curves correspond better in the dimensional factor, while there differences are more evident in the affective factor.





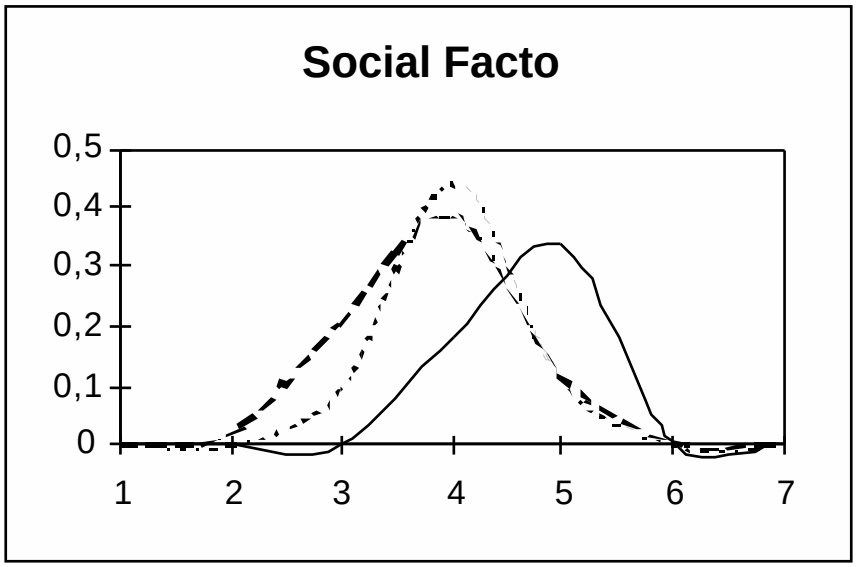


Fig. 5 Estimated Normal Distribution.

Conclusions

From the analysis of the results we can assume that the RSM and the CGM can be considered as ecologically valid, because with them the psychological impressions of people will be equivalent to that of a real space. Even though, on a general level, the perception of the RSM seems to be more similar to that of the Real Space than the one produced by the CGM. The analysis by factors shows that both models are similar to the real space on the dimensional factor but only the CGM can be considered as matching on the social factor. This difference between the two models tend to indicate that the amount of details rendered by them affect the way that they are perceived. The RSM allows very few modifications of variables considered important to recreate reality (color, texture, etc.) while the CGM is more flexible. This influences the amount of information that each model can afford, thus changing the social and affective perception of the space. The visual analysis of the estimated normal distribution of the evaluations grouped by factor confirm the idea that these models represent well the dimensions of a space but do not afford enough information as to be representative of its affective and social character. The RSM and the CGM, at there actual stage of development, will never replace real space, but with more knowledge of there advantages and limitations it will be possible to use them in an affective way as surrogates of real space or as a means of controlling variables when studying the built environment.

References

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