

From physical models to immersive collaborative environments: testing the best way to use representation for homeless people visualise and negotiate spaces

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Abstract. This paper describes an experiment to investigate the best way to use representation for lay people visualise and negotiate spaces. It departs from three main questions. First concerning the effectiveness of different media to represent spatial quality; second concerning the best way for novices to approach space, whether refurbishing it or starting from the scratch; and third concerning the effectiveness of negotiation by means of discourse and by means of action. It also discusses two main hypothesis: one coming from research on digital environments and stereo visualisation, indicating that the more people feel immersed in the represented environment the more they are able to correlate it with physical space; and the other coming from our own observations in participatory design workshops, in which the collective decision-making was manipulated by those with more advanced communication skills, a condition easy to revert if people are acting instead of talking.

The experiment was an exercise of spatial negotiation in five versions: one using digital views in plan and axonometric; two using a physical model; and another two using a 3D interactive digital model. We have concluded that 3D interactive digital models are far more effective than physical models and 2D drawings; when negotiation happens by means of action it provides more creative results than when the discursive practice prevails; although spending more time people are more creative when they start something from scratch. The results led us to formulate a new hypothesis developing an immersive collaborative environment using stereoscopy.

Keywords. Digital interface, homeless people, immersive environment, negotiation, visualisation.

I. INTRODUCTION

In 2005 EVA (Virtual Studio of Architecture) was hired by Finep (Funding agency for studies and projects) to develop a pilot for the new governmental programme Crédito Solidário, a sort of common-interest credit directed towards self-management of housing schemes. We have worked with ASCA (Homeless Association of Belo Horizonte) for the inclusion of the community in all stages of design to build a housing scheme for 77 families [1]. The focus of this paper is the set of digital interactive interfaces and the workshops for digital inclusion preparing the community to use computers and understand representation.

For the digital inclusion we have designed a set of interactive digital interfaces, using the software *Macromedia Director*, to enable community members to learn the basics of computers with content related to the housing. The interfaces were used in workshops with groups of 10 people in average. According to Ballerini [2], the first barrier to overcome for novices using computers is the disposition of the letters in the keyboard, with which people are quite uneasy and end up creating a blockage to move forward. So, the first set of interfaces was designed to solve this problem starting by only using the mouse and introducing the keyboard later.



Figure 1. Workshop for digital inclusion.

Teclado 2

A B C D E F G H I J K L M N
 O P Q R S T U V W X Y Z @ # \$
 1 2 3 4 5 6 7 8 9 0 ESPAÇO APAGAR

Figure 2. First interface proposing the task of filling a form using a digital keyboard.

Before starting the exercise proposed in the second interface, an animation of the letters from the digital keyboard in alphabetical order going to their position in Qwerty's keyboard was played.



Figure 3. Intermediary frame of the animation of the organisation of the letters in the keyboard.

The second digital interface regarded user's environmental preferences. It was designed to stimulate people not only to use the actual keyboard and repeat the use of the mouse—by clicking and dragging—but also to start thinking about their preferences concerning the place they would live in. Instead of providing a set of images to be chosen, the interface has fields in which users are required to write that which comes to their minds. For each preference a symbol appears and users drag the symbol and place it in order of their preference in the squares at the bottom of the page. Though very simple, it is quite effective for introducing the use of the keyboard quite naturally, and, mainly, for starting a process of real participation in which people are not required to choose among predefined things but to think independently.



Figure 4. Sequence of use of the interface of preferences.

The average time for going through these first interfaces is little more than an hour. Before using the last two digital interfaces people are required to build a room using a set of cardboard modules of 1 m² to discuss notions of area and volume.



Figure 5. Cardboard modules in 1:1 scale used to assemble an environment in real size.

Back to the computer people are required to use two interfaces that represent plan and perspective of the space they have just built with the cardboard modules. In the first one people are required to organise tiles on the floor, experimenting in abstraction the same process they have just gone through in real scale. This raises questions concerning scale and spatial notion in architectural representation. The second one repeats the same space in plan and perspective, but this time people are required to organise furniture layout. In both cases users can operate simultaneously in plan and perspective, as everything done in one is automatically represented in the other.

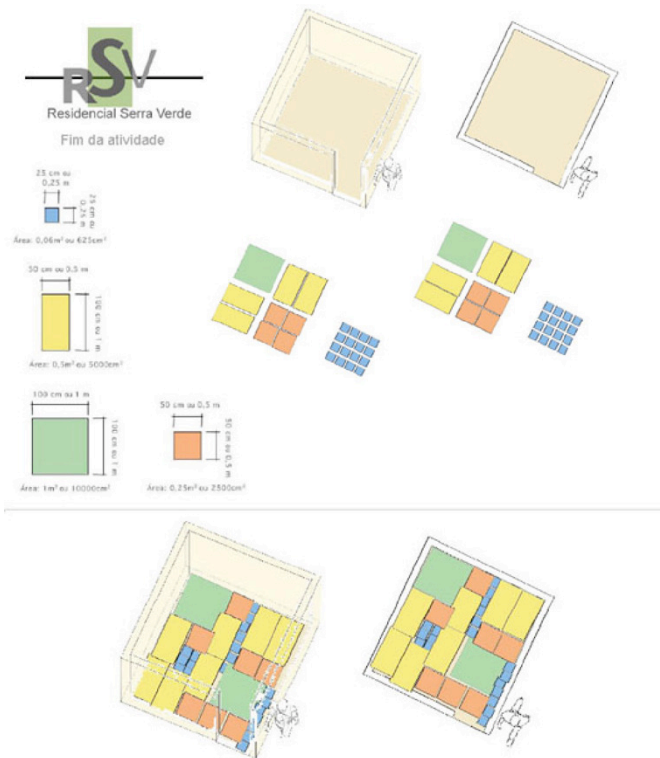


Figure 6. Interface for the introduction of notions of representation of area in plan and axonometric (initial screen and the result after used).



Figure 7. Interface introducing the representation of lived space by means of layout in plan and axonometric.

After the first two workshops we concluded that we have sorted out the problems raised by Ballerini and that certainly the interfaces were effective to get people involved and learn to use mouse and keyboard. However, with regards to the last two interfaces we could not say whether or not people could really understand the space. We could only know that they had a notion of representation, but we were not able to tell for sure if they were merely solving a puzzle or if they were really able to have an idea of the space represented.

Since having people really involved and knowing what they are deciding on is crucial to the success of the housing project, we needed to find the best way we could possibly use for architectural visualisation and negotiation. We, then, decided

to set an experiment to compare the usability of different media in participatory design processes. The usability test is a qualitative evaluation developed for analysing digital interfaces, and might also be used for objects and other usable things, done by means of tasks to be performed by different people. The observation of such performances and people's comments during and after using the interfaces are crucial to the researchers' conclusions. According to Nielsen and recent experiments done by Fhios, testing the interface with five people is enough to raise most problems, correct them and test again [3]-[4]. Following this methodology we set up an experiment to test different kinds of architectural representation, ranging from physical to digital models, used in different ways, as we also wanted to check how the community would feel more involved discussing their own spaces. These different architectural representations became part of the following workshops of digital inclusion.

II. SETTING UP THE EXPERIMENT

The experiment was set as an exercise of spatial negotiation in five versions. The first version is the one we have used in the first workshops, fixed views of plan and perspective, which we had already evaluated; for another two versions we provided a physical model of the room in 1:10 scale, with some pieces of the existing furniture in different scales. This was done to check if people were just playing with a puzzle or actually grasping the correspondence between representation and the object or the space represented. One version proposed refurbishment and the other started from the scratch. And the last two versions repeated the same task made with the physical model, but this time using a 3D interactive digital model. People were required not only to organise the furniture in the space but also to build a full scale cardboard structure and organise the real furniture reproducing their proposed model. Their comments on the spaces they had built confronted with what they had imaged when working with representation has enabled us to compare the different media, as also the different ways of negotiating spaces.

We had three main questions when setting up this test: first concerning the effectiveness of different media to represent spatial quality, as we had already seen that the fixed plan and perspective with which people interacted were efficient as concrete objects—good puzzles—but we could not say they were effective as representations of physical spaces; second regarding the best way for lay people to approach space, whether by refurbishing a pre-existing space or by starting from the scratch; and third concerning the negotiation process, whether the power of negotiation should be discourse, as in most negotiation processes, or action, by means of proposals to be collectively constructed. We had two main hypothesis: one coming from researches on digital environments and stereo visualisation, making us speculate that the more people feel immersed in the represented environment the more they are able to correlate it with physical space [5]-[6]. The other came from our own observations in the participatory design workshops, in which the collective decision-making is severely influenced by those people with more advanced

communication skills who use their ability in an authoritative way regardless of having or not good ideas. We have noticed in the very first participatory design workshop, with about 20 people, that most participants were inhibited by very few who actually had little to say but imposed their views instead of starting a discussion, instead of engaging in a negotiation process.

As the main idea was to verify the best way for people to understand space by means of representation, so we needed to find a way to check it. This is not a quantitative measure, but we came to the conclusion that a simple means to evaluate that would be by comparing the diversity of results and the group's declared satisfaction. We needed then an exercise that used representation to design and negotiate, but also produced a physical result in real scale for the participants to comment on their expectations and frustrations in the passage from representation to real scale. As we knew that the coffee break is always highly expected, we have proposed an exercise with the model of the room in which the workshops happened, asking them to design the space for the coffee break within that room using the 1 m² cardboard modules and some available tables. They need to represent it in the model and then build it in the room. This creative process always involved negotiation.

In the first workshop including this experiment we have proceeded the first part of the digital inclusion as usual, and then asked the group to use the pieces of the physical model to first reproduce the room and layout of the furniture and second to create a space for the coffee break using the cardboard modules. The second version was almost the same, but this time we have given them the room already assembled with some pieces of furniture inside, and asked them to complete it and create the space for the coffee break using the cardboard modules. The same was done with the 3D interactive digital interface in 2 versions (refurbishing and from scratch) in other 4 workshops.



Figure 8. Leader-group relationship in the use of the physical interface.

The first difference from the physical to the 3D interactive digital model is the process of negotiation. As there is only one physical model people need to negotiate as they proceed in assembling and creating the space for the coffee break. When using the digital model, each participant plays with the

model individually and only then starts the negotiation process. Another difference concerns abstraction, happening more naturally when dealing with representation in the 3D interactive digital model, in which the scale was not fixed, than with the physical model with fixed scale.



Figure 9. 3D interactive digital interface.

Comparing the different versions of the exercise we can say that those intrinsic features of each model really make the difference. The groups using the physical model in both versions reproduced the behaviour we had already noticed in other occasions. Usually one takes the lead and the others are inhibited by this leader. In all cases one leader immediately appeared and the others started to help him, reproducing in a micro scale the usual division of labour. What impressed us most was the easiness with which the majority of people just give up the opportunity to discuss things by not believing they have something to contribute. Another aspect of establishing an immediate leader-group relation is the fact that the leader feels obliged to have right answers fast, not to loose the leadership, and because of that ends up not speculating at all. In all the tests of this experiment the ones with the physical model and the leader have produced the least creative or most obvious results.



Figure 10. The simple cardboard arrangement of the coffee break space, which has enabled us to compare how people feel about the correspondence between the real space and its representation using different media.

III. RESULTS AND CONCLUSIONS

After the tests with the 3D interactive digital model, we came to the conclusion that everyone in a very short period of time is able to offer an insight for discussion, even if a very specific contribution. They just need a bit of time to have their own thoughts. People using the 3D interactive digital model were able to understand the proportions of the space in relation to the furniture, having no difficulty in choosing the right size furniture, different to the groups using the physical model. All 3D interactive digital model users came up with a different idea for the coffee break space. Different to the leader-group behaviour, in which the leader established the direction and the others just followed without raising parallel or crossing questions, in this case people were able to manifest that which were really important for them in a coffee break space. For instance, some would focus on privacy from the work space, as others would focus on the size of the table to avoid people queuing to get the coffee and food, and others were more worried with creating a space to stimulate conversation. After that it became even difficult to negotiate as all of them wanted their ideas to be 'chosen' and not discussed. However, as they were required to build a single coffee break space, they ended up collaborating and arrived at quite reasonable results having one proposal as the basis and adding up some features they thought to be important after discussion.

Regarding the refurbishment or starting from the scratch, we mainly found three things. First: the groups using the physical model took much longer to understand the space than everyone else using the 3D interactive digital model when the proposal was to start from the scratch; they also took longer, but not so much, when refurbishing. We attribute this to the almost natural abstraction proposed by the model with no fixed scale in the computer as opposed to the object-like physical model. Second: all the groups performing refurbishment were much quicker than the groups starting from the scratch. We attribute that to the easiness to move pieces around as in a puzzle without actually thinking of the

space. And third: all the groups performing refurbishment were not so creative as the ones starting from the scratch. We attribute that to the fact that the pieces already placed in the space indicates a direction to be followed, as when the pieces are not present people really think more of the potential of the space.

We know that we have not tested it so extensively as to confirm our findings beyond doubt and to be able to write a scientific paper on it. But, so far, we can say that the groups working with 3D interactive digital models manifest in a much more positive way regarding their satisfaction with the correspondence between representation and the space created than the groups using the physical model. Another thing we may assert is that the groups working with 3D interactive digital models from the scratch, though taking longer, were much more able to understand and propose creative spatial changes than the others.

From these tests we have noticed that the more successful was the 3D interactive digital model, with which people got more involved and seemed more able to visualise representation as an abstraction of a real space. Our observations made us speculate that perhaps people tend to see physical models, printed drawings and computer models with fixed scales as concrete objects, making it more difficult to start the abstraction process. With the 3D interactive digital model, due to its lack of fixed scale, people are already working with abstraction from the beginning, and this is perhaps the advantage of this kind of representation. Another point we have observed is that when given a bit of time alone to play with the model each user was able to get much more involved and bring more ideas to the discussion process.

The final conclusion concerns the way we observed people acting. The media used have influenced people in their exercise of abstraction or, on the contrary, in their attachment to concreteness. Our observations led us to conclude that the more abstract is the model the more immediately people resort to abstraction and are able to feel immersed in the representation of space. In order to advance our research in media that enable such an abstractive behaviour, we are resorting to developing low-tech and low-cost stereoscopic interactive immersive digital environments, a research in progress at EVA. Besides enabling the sense of immersion (scale and surrounding), it also enables negotiation in action as people can collaborate with each other in the construction of the digital representation of space. This means that people may experiment the space by themselves and have their own feelings and ideas while simultaneously interacting with other people in the environment. Such an immersive environment, due to immersion and stereoscopy, shifts the focus of representation from concreteness to abstraction and from spectacle to experience. In this way we believe that such a stereoscopic interactive immersive digital environment will surpass the results we have achieved up to now, becoming even better means for lay people to correlate representation with the actual space represented.

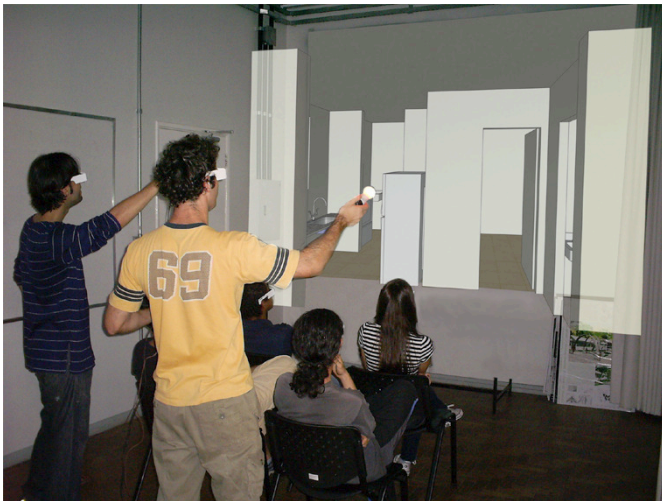


Figure 11. Experimental stereoscopic interactive immersive digital environment using two projections with linear polarizer filters and polarized glasses for visualisation. The interaction happens by gesture using lamps of different colours working as the input by means of the plug-in TTC-Pro in the model running in Macromedia Director.

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REFERENCES

- [1] A. P. Baltazar and M. L. Malard, "RSV—Residencial Serra Verde—participative design process and self-management of low-income housing construction in Belo Horizonte, Brazil," in *Affordable Design: Convening the Conversation: Final Report*, Washington: ACSA/ Fannie Mae Foundation, 2006, pp. 35–46.
<http://www.lafoundation.org/images/casestudyseries/Affordable%20Design-Final%20Report12-18-06.pdf>
- [2] F. Ballerini, *Sistemas interativos digitais e processos participativos de projeto: um estudo de caso: Mutirão São Gabriel*, Masters Thesis, Escola de Arquitetura, Universidade Federal de Minas Gerais, Brazil, 2002.
- [3] J. Nielsen and D. Norman, "233 Tips and tricks for recruiting users as participants in usability studies", *Group Report*, <http://www.nngroup.com/reports/tips/recruiting/>
- [4] Fhios website – <http://www.fhios.com>
- [5] Department of Computer Science, University College London, Research on Presence lead by Professor Mel Slater - <http://vecg.cs.ucl.ac.uk/research/presence/>
- [6] R. Hawkins, *Digital Stereo Video: display, compression and transmission*, Masters Thesis, Master of Philosophy at The Australian National University, 2002.
http://escience.anu.edu.au/research/papers/02_Rhys_Hawkins/thesis-small.pdf

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