What Makes a House?

- Approaching Architectural Design in Virtual Worlds

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Abstract. Many of the virtual worlds that exist on the net today look very similar to physical environments. Existing research and our own experiences indicate that this design approach is problematic. In this paper we highlight some of the problems with what we have labeled the realism approach to virtual world design. In search for an alternative approach we begin by considering the opposite extreme, a non-realistic approach which also is criticized based on existing theories from landscape architecture, psychology and virtual environment design. Then we perform a small thought experiment to come up with a middle ground called the functional approach. This is followed by an account of a design project called Confuse where this approach was tested and evaluated. Based on the experiences from that project we conclude by presenting a refined approach to virtual world design called the interaction approach.

1 Introduction

Some computer systems give the user access to shared spaces on the net; arenas for communication and interaction. The design of these places is different to designing tool-like applications. The system that gives access to the arena might still be thought

of as a tool, and the person sitting in front of the screen, a user. But more importantly, he or she becomes a participant in a virtual world (Croon Fors & Jakobsson, 2000).

When we us the term virtual world (VW) in this context we mean the phenomenon of a shared virtual space. VWs can differ substantially in terms of purpose and design, nevertheless there are four basic features that are always found in what we define as VWs. First, all VWs support the feeling of presence. By presence we mean that the system allows for a feeling of being at the same place as other users of the system although residing at different locations physically. This means that the system must give the users an environment that they can attribute a sense of place to. Contrary to popular belief among people who have not experienced VW technology first-hand, it does not take very much to make participants feel presence, but graphical systems tend to evoke it more intuitively than text-based systems.

Second, all VWs offer the possibility to interact with other people. A VW is thus distinct from e.g. a single-user, three-dimensional virtual environment that also evokes a sense of presence but where you are chronically alone. A third characteristic that all VWs share is that they are persistent. When you exit a world it will still be there and things will continue to happen in your absence. In this sense, network computer games such as Quake are not VWs, since they are sustained only for the duration of the gaming session. Our fourth and final criteria is that there has to be some kind of representation of users and objects in the environment, so that you know when you are in the presence of others, if there are any objects there etc. This implies that the system is based on some kind of spatial metaphor. This excludes e.g. a web site from being a VW.

VWs of different incarnations have been around for some time now. The origin of the text-based MUD systems can be traced back in time almost all the way to the birth of the electronic computer and the first graphical VW system was introduced back in 1985 (Morningstar & Farmer, 1991). So the phenomena as such is not entirely new anymore but the theory development concerning how to design and build VWs successfully still has a long way to go compared to e.g. traditional architecture.

Many of the buzz words of the 3D graphics scene – such as *virtual reality*, *photorealistic rendering*, and *Reality Engine* – allude to the idea of a perfect simulation of physical reality. A system like the Holodeck in Star Trek that is so convincing that it is impossible to distinguish the copy from the original. The Holodeck is treated as the Holy Grail of VW development. But in this paper we will argue for an alternative direction for the field of VW design. We do not think that the reproduction of the physical world without taking into account the unique properties of VWs as a medium is the best way to go. We also believe that the dream of the Holodeck will remain exactly that for all foreseeable future.

This leaves us with a very simple question. If design for VWs is something radically different from design for the physical world, then what is it? Unfortunately, simple

questions are often very hard to answer and this one is no exception. So instead of trying to take on the whole question head on within the scope of this paper, we will focus on the search for a foundation for VW design. First we highlight some problems with the realism approach to VW design and consider the opposite extreme of non-realism and review some existing research. Then we perform a little thought experiment to come up with an alternative that we have labeled the functional approach. This is followed by an account of a design project based on the functional approach. Based on the experiences from that project we conclude by presenting a refined design approach to VWs called the interaction approach.

2 Design for Realism

When facing the challenge of VW design, realism seems to be the most common approach. ACTIVE WORLDS (AW) is a widely used VW system where participants interactively build their environment. Roaming through the many worlds in the AW universe, you will notice that many designs tend to mimic the physical world. The basic assumption seems to be that it is best to shoot for the Holodeck even if the system is far away from offering the technological sophistication needed to even come close, i.e. making the virtual as "real" as possible. Another explanation is that it is the act of building rather than the result that is the focus of attention behind these creations. Perhaps the participants mainly were interested in exploring the possibilities of the system and in a rather non-reflected manner just built whatever came to mind.

It is not very surprising that people come up with environments reminiscent of physical cities since the system itself has some inscriptions pointing in that direction. It is up to every world owner to decide what building blocks to make available in a world but there is a standard set of objects that is used unless something else is specified. The standard set consists of walls, roofs, flowers, roads etc. In fact, when a new world is started there is only one object in the whole world and that is a piece of road located at the center of the world. The world also has a ground plane which is a prerequisite for simulating gravity in the world. It is as if the system designers wanted to say that you can build anything you want but you will probably want a flat ground plane, gravity and a road. Especially the road is a bit surprising since there are no cars included in the standard set of building blocks.

Consequently you will find many virtual towns that look like physical towns, with streets leading to houses similar to buildings seen in the physical world. The houses are built with walls, a roof, windows, a front door opening and nice lawns in front of them, just like the ones you might find in your everyday physical environment. The towns even have a distinct touch of western society to them. (See fig. 1)

A tour through the existing VWs also tells us something about the consequences of the non-reflective design approach. These worlds are often empty of people; they are virtual ghost towns. It gives a strange and somewhat desolate feeling to walk around on roads where no cars will ever pass, looking at flowers that does not grow or peeping in to empty houses cautiously fitted with roofs sheltering from rain that never falls. It seems as if these replicas are not very successful when it comes to attracting visitors or being the place for frequent activities. On the contrary, worlds that very closely reflect the physical reality seems destined to fade into oblivion in the sense that they do not attract people for a long period of time and quickly become uninhabited.

Figure 1. A typical building found in the AW system. (This building is located in the world “AWSchool”).

When trying to transfer physical environments to the virtual we also import physical limitations and constraints so why try to create a copy of the physical reality when we already have the original? The copy can not measure up to the original and will not offer the same functionality. Physical environments are designed for doing physical things and when they are reproduced virtually, a gap reveals itself between the activities that might be meaningful to engage in within a VW and what the environment supports. There is, however, one activity that the worlds support very well and that is building. It is very easy to build things as long as you use the pre-made building blocks, and the process is often seen as both fun and engaging. This explains why AW has kilometer after kilometer of uninhabited environments. They were not designed to support any activity. The meaningful activity was the construction of the environment. But does it have to end with that? Is it not possible to design environments that support other activities? To do this we will have to reconsider the

claims for realism and instead focus on the VW medium as such, its characteristics and possible use.

3 Rethinking the Realism Approach to VW Design

Moving outside of the boundaries for physical architectural design, we will discover that VWs offers both new possibilities as well as new restrictions. As Bridges & Charitos (1997) points out, there are no rules to dictate the dynamic nature of virtual environments. There is no gravity or friction unless we design them. Space is noncontiguous and multidimensional, violating the principles of real space. In addition there is no scale consistency, giving us the opportunity to change the scale of the environment when it is appropriate.

If these are some of the many potential benefits with designing virtual space, one should also consider the constraints within this new environment. The technique used to visit VWs is not flawless. While having five senses to experience the physical environment, most output devices connected to VWs systems only provide feedback for two senses (visual and auditory). In addition, the feedback given is not sufficient to give the user a satisfactory notion of the representation of their body in the VW (Bridges & Charitos, 1997). VWs cannot be compared to the physical reality when it comes to achieving multi-sensory experience, which again underlines that they should not be designed as a duplicate of the physical world, i.e. not primarily aim at realism.

The obvious opposite to realism would be non-realism, an environment that does not look or behave like anything previously known. When searching for a design approach that is suitable for VWs, let us first consider the extreme of non-realism. Entering a VW with no similarities to the physical reality we usually live in would certainly be a confusing experience. Having lived our entire lives in a physical world, it would be very hard to comprehend an environment with no reference to that world. We would try to orient ourselves in the environment, looking for landmarks, signs, buildings, anything that could help us understand what the place was all about. As stated in traditional environmental design (Lynch, 1960) we need those clues to orient ourselves in any environment and in their absence we would probably end up being paralyzed, unable to interact with the environment since we would not know how to do.

Cyberspace theorists such as Anders (1999) and Heim (1998) accordingly conclude that although the real can not be reproduced in a virtual space one should not try to replace realism by pure fantasy. We need some points of reference to previously experienced environments (i.e. physical space), in order to understand the virtual space. Also in the perspective of Gibson’s (1986) ecological approach to perception, which puts emphasis on the embodied nature of our way to perceive our environment, the extreme non-realistic approach to design does not appear to be a good solution.

The path between the two extremes leads to a concept where the qualities of the VW are in balance with the maintaining of references to the physical world. While realizing that we do need to incorporate clues from the physical reality to enable users to comprehend the virtual environment, the opportunities for innovative design still remains. This design concept comprises an understanding of the intrinsic qualities of VWs, aiming at a design with features that match those qualities.

4 What Makes a House?

Let us consider for a moment what the differences actually are between building a virtual house and a physical one. This comparison is very hard to do without having some kind of context for the task, but bare with us please. Let us say that we want a place where people can meet for different types of intellectual interchange, a conference center of sorts. Unless the virtual environment has a working ecosystem we will not have to have walls and roofs for the sake of keeping the participant sheltered from rain, wind, snow, or cold weather. So what else would we need a wall for? One thing is that if we had no designator of where people should gather, they would probably have a hard time finding each other. So the walls would serve as designators of a place, something that could be marked out on a map or referred to in a route description. But we would not need walls for this; a simple “X” on the ground would suffice.

But walls can also isolate an area so that sounds from the outside are kept from coming in and vice versa. This is a very desirable feature in a conference center where you want to be able to have different activities going on at the same time without them interfering with each other. Unfortunately, a virtual wall might very well be thick as a Guernsey cow and still be totally unable to stop talk from flowing right through it if the talk is constituted of typed-in utterances in a separate chat box. Another important aspect of walls is that they contribute to the atmosphere of the room. If you for some reason want to evoke claustrophobia you should probably put the walls really close to each other, but you can probably also create an atmosphere of intimacy by keeping people in close proximity to each other. Walls will of course also have color and texture that will affect the atmosphere of the room and can be used e.g. to show images on.

So walls are much more than just shelter from the storm and we will probably continue to need them also in virtual environments, but what will they look like? Normally walls are very straight and upright but perhaps that mostly has to do with the characteristics of gravity. In a virtual environment, where gravity might affect only the avatars (the graphical representations of the participants) and not the buildings, or perhaps not exist at all we might want to experiment more with shapes and curves. And

if the material we use has no weight we can build vertically just as easily as horizontally.

This might makes us wonder why Alpha World (one of the largest worlds within the AW system) looks so similar to Los Angeles but there are more reasons for this than those we accounted for in the previous section. There is a very tight limit to how much you are allowed to build within any given cell in AW. A cell is ten times ten square meters in the horizontal plane, but infinite (within the confides of the system) in the vertical plane. This means that there are severe restrictions to how high you can build but not to how wide. Similarly the fondness for objects of fairly simple geometry with sharp edges and flat surfaces is connected to the fact that other objects would put a harder strain on the rendering engine that translates information in the world database to a graphical environment on a participant's screen.

Yet another possibility in zero-gravity architecture is to give up the idea of "up" and "down". This could be done partially, as in *2001 – A Space Oddessy* where "up" is in different directions in different parts of the space ship, or full out without any decision made by the designer as to how the body ideally should be aligned in reference to the room. There are, however, indications (Charitos, Bridges & Martakos, 1999) that this kind of freedom is more distracting than liberating and that people try to find an "up" and a "down" based on angles, size of surfaces etc. although no such clues have been deliberately put there.

This thought experiment points in a direction where the function of the environment is the starting point of the design. Since we do have ideas about what we want to do in the VWs but not what they should look like, why not take the activities themselves as the starting point for a function centered design approach.

5 Confuse – Building a Virtual Conference Center

In the beginning of 1999, the Swedish Polygon Company (a group of four Ph.D. students in informatics, created exclusively for this project) was appointed by the Department of Informatics at Umeå University to design a virtual conference center located in AW. The aim was to develop a conference center for academic sessions such as presentations, lectures and discussions in a VW. The design project was named Confuse (short for "conference use") and lasted for about a year.

Only one of the participants had prior experience of designing VWs, but partially inspired by Heim (1998) we all agreed that VWs should be viewed as something fundamentally different than our physical world. Accordingly, a virtual conference center should not necessarily inherit the features of a physical one. Still, we soon agreed that the center probably could benefit from having some similarities to the physical counterpart. It would probably be a good idea to create a building with rooms

in different sizes, according to their intended use. We also wanted some kind of entrance to the building, with a lobby where people could meet before and after different events. From the lobby, paths should be used to guide people to the different rooms, making it easy to find your way around. Stairs were also used to guide visitors between the two floors. This was in one sense unnecessary since users quite easily can fly to the second floor of any building. Still we thought that it had an aesthetic value and also, more importantly, it made the conference center more intuitive to navigate.

So much for the realism though. Within the created framework that alluded to physical conference settings, the design was completed with features fitting a virtual environment. One obvious example of this approach was the design of the main lecture hall. Considering the avatars' inability to sit, there was no need to equip the room with chairs. Furthermore, we skipped the typical projector and silver screen, as those tools for communicating would not be useful within this new setting. Arriving at conference centers, one is often provided with writing materials, pens and papers to take notes during the sessions. This, of course, is not needed in a virtual conference. Instead chat logs along with screen captures (taken with the computer used for entering the VW) is quite sufficient for this cause. Consequently a lot of things usually found in a typical conference center could be left out in the design since they where not needed and clearly did not fit in a VW. Still some similarities to physical buildings were used to help communicating our intentions to the visitors about how the place could be utilized. (See fig. 2.)

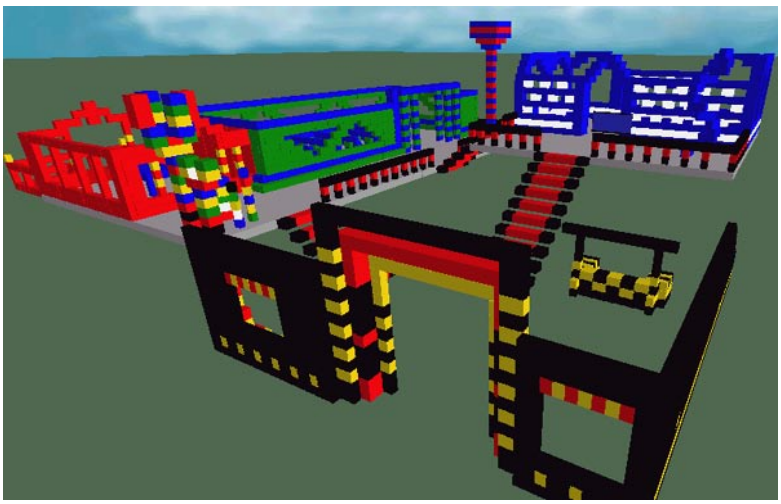

Figure 2. The conference center.

The virtual conference center is hardly the perfect mix between realism and non-realism. However, it represents an attempt to design for the functions of a place instead of replicating the structure of a place, while taking unique properties of VWs into

consideration. But as later events in the conference center would show, we still had lessons to learn about how to design a building intended for virtual conferences. It appeared to be somewhat difficult to predict the different kinds of interaction that would develop, thus making it hard to make a perfect design. Still, we also experienced situations where the design solutions implemented offered an adequate setting for the occasion at hand, which strengthened our assumption that the design work should focus on the functions it is supposed to accommodate.

6 Design for Interaction

In the Confuse project we made an attempt at focusing on the functional aspects of the environment rather than its structural and visual properties. We used a building material that was rather featureless, modular and very easy to reconfigure and tried to fit our constructions as close as possible to the functions they were supporting. Since we wanted to make a place that supported meetings in groups of different sizes we tried to make a number of rooms that were spatially adjusted to accommodate certain numbers of participants.

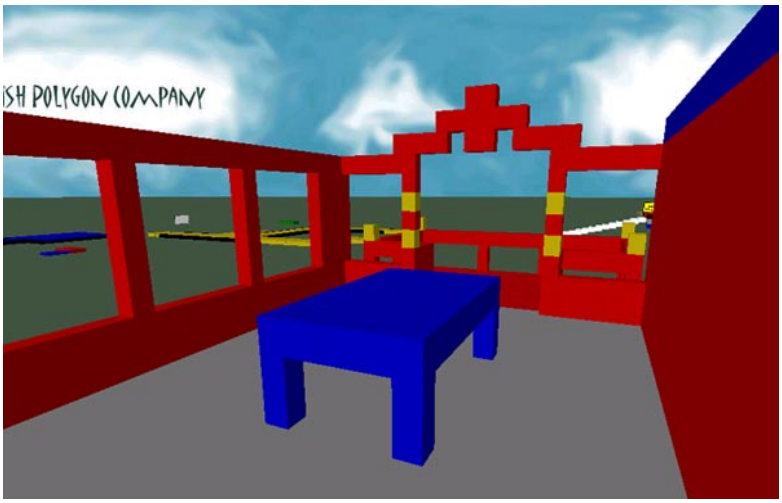

Figure 3. The small meeting room.

The first room was made for two to four participants. In the middle of the square room a table was placed so that the participants would naturally position themselves facing each other at an appropriate distance. One of the observations we had made before starting to design Confuse was that people who are listening to a presentation in a virtual place tend to behave restlessly. If they are given a wide open space to scatter their avatars over, they tend to move around during the presentation which in turn often

has a negative effect on the presenter. So we used positioning cues like the table to subtly suggest to people how to position their avatars and hoped that these cues also would dampen the degree of restlessness. (See fig. 3.)

For the same reason we installed fence-like structures in the large lecture hall. Since the world was limited to a maximum of sixteen simultaneous participants, the lecture hall was designed to take up to sixteen participants. We made the assumption that if there are more than eight participants, the mode of interaction will probably be in the form one to many, so we put a podium at the front and lined up the fences to face the podium. The podium was positioned to the side so that the front wall could be used to display images or video. (See fig. 4.) The third room was customized for between four and eight people. No positioning cues were put in this room but we had plans to eventually do so. (See fig. 5.)

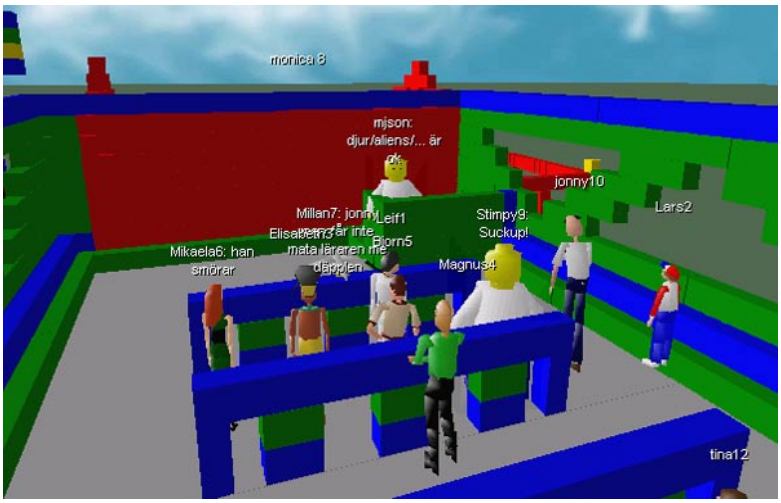

Figure 4. The lecture hall.

One idea behind the designs was that walls of a room are needed to create togetherness through proximity and exclusion of everything else in the environment by using the wall as a border encapsulating the activity. Thus the walls did not have to be solid. The non-solidity of the walls also served as a signal to the participants that what was said in one room also could be heard by people outside the room. There were no roofs and entrances and exits did not have any doors. We had taken a step away from realism, with its focus on structure towards a focus on the processes that the structure was there to support. Traditional architecture is of course also aimed at supporting processes but without many of the material constraints of the physical world, this could be taken much further.

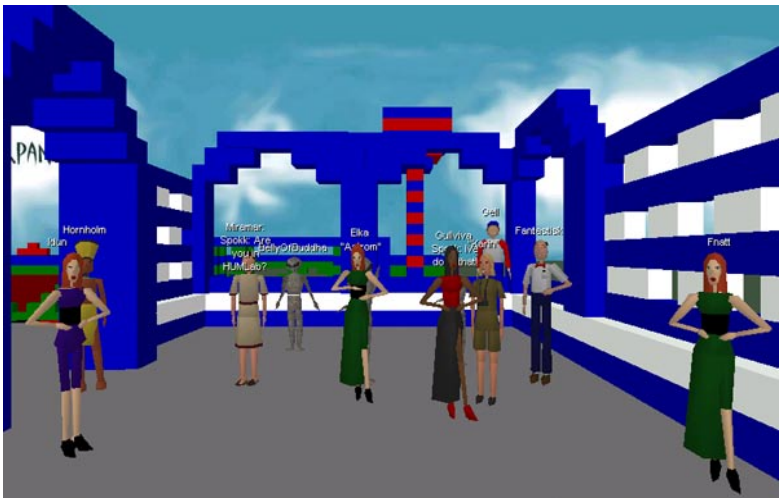

Figure 5. The group room.

But all was not well in our function-oriented environment. Early tests made it clear that the assumption that the processes to support meetings and lectures are fundamentally the same in a virtual as in a physical setting was invalid. Instead we found that the medium affected also the procedural issues. One example of this is when we tried to give presentations in the lecture hall. Unlike presentations in physical lecture halls, the students did not feel a need to keep quiet while the presenter was talking. This should not have come as such a surprise since we know that when the communication is text-based it is possible to "hear" what people say even though more than one person is talking simultaneously.

A presenter is seldom allowed to speak more than a few sentences before the questions start coming from the audience. The natural consequence is to try to structure presentations in VWs as a kind of Q & A sessions rather than traditional presentations. This makes it crucial for both the presenter and the audience to learn to master the "chat" conversation style, which entails keeping track of several intertwined conversation threads and keeping utterances fairly short.

Another consequence was that we felt that the lecture hall we had built did not support the process that was actually taking place. We had noticed that presenters got nervous when the audience was moving around, and tried to remedy this by keeping the audience from moving around. But in a VW it is perfectly natural to move and listen at the same time. It does not keep you from hearing the presenter and you do not make disturbing noises. So the solution was not to keep the audience from moving but to make the presenter move too and make the movement a natural part of the presentation. The lecture hall was soon abandoned.

If we discard realism as a goal for VW design we need a new focus. We will also have to deal with the theoretical void where theories from traditional design,

architecture and urban planning used to be. Where they focused on things like characteristics of the physical building materials and infrastructure VW designers deal with a material that is virtually (no pun intended) devoid of properties in an environment where teleportation can more or less replace transportation. But there is one thing that remains constant going from the physical to the virtual and that is the people. And people will always be interacting with each other and their environment.

In the Confuse project we learned that progress can be made by shifting the focus from structural towards functional aspects of the environment. But this was not enough since the functional aspects change in unpredictable ways when activities are virtualized. Our answer to this dilemma is to go past both structural and functional aspects as given starting points for the design process. We have to look at which structures and which functions that are needed to support the *interaction* that the place is intended for. This is the interaction approach to VW design.

7 Conclusions

As the VWs of cyberspace becomes inhabited and develop into livable communities, there is an increasing need for good design solutions. We have argued that the typical conception of aiming at realism does not match the qualities of VWs. The rules and guidelines within the areas of traditional design and architecture does not apply to VWs and consequently we have to find new design perspectives suitable to the new environment and the kind of activities that are to be carried out there.

This paper does not embrace the whole issue of what design for VWs should be, but rather tries to find the core of VW design, one that can function as a foundation and starting point for future designs. We argue that the essence of VW design is one of interaction. When designing VWs we need to take into consideration the interaction that is to be supported, and focus on that throughout the design process.

What will the VWs of tomorrow look like? Surely there will be a variety of appearances and most certainly they will also support quite diverse functionality and interaction. Still, we believe that their level of success will depend on whether they have been designed for interaction or if they have used design concepts inappropriate for VWs.

VWs have the potential of hosting livable communities, but that potential is imprisoned by badly adapted design concepts. A shift of the design focus towards an interactional approach can probably accommodate our needs much better.

References

Anders, P. (1999), *Envisioning cyberspace: Designing 3D Electronic Spaces*, McGraw-Hill, New York, NY, USA.

Bridges, A. & D. Charitos (1997), 'On architectural design in virtual environments', *Design Studies*, **18**(2), 143-154.

Charitos, D., A. H. Bridges & D. Martakos (1999), Investigating Navigation and Orientation within Virtual Worlds, *in* 'Interactions in virtual worlds. Proceedings of the fifteenth Twente workshop on language technology', Enschede, The Netherlands, May 19-21.

Croon Fors, A. & M. Jakobsson (2000), Beyond use and design - The dialectics of being in virtual worlds. 'Internet Research 1.0: The state of the interdiscipline', Lawrence, KS, USA.

Gibson, J. J. (1986), *The Ecological Approach to Visual Perception*, Lawrence Erlbaum Associates, London, U.K.

Heim, M. (1998), *Virtual Realism*, Oxford University Press, New York, NY, USA.

Lynch, K. (1960), *The image of the city*, MIT Press, Cambridge, MA, USA.

Morningstar, C. & F. R. Farmer (1991), The Lessons of Lucasfilm's Habitat, *in* M. Benedikt, ed., 'Cyberspace: First Steps', MIT Press, London, U.K.