Issues and Questions for Research in Communicating with the Public through Visualizations

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1 A Problem Statement, Modes of Communication

'Visualizers' are often just concerned about the visualizations they are producing, i.e. they are concentrating on the medium. There is no doubt that there is still a wide gap of research in this area, especially in terms of perceiving visualizations and in terms of providing 'credible' visualizations (see BISHOP & LANGE, 2005). SHEPPARD (2001) has elaborated a code of ethics for visualizations. When we consider however the real-world context of how decisions in planning and design are made, we have to be aware of the fact that our visualizations hardly ever just speak for themselves, despite what we might believe.

When visualizations are used in a decision making context, and fortunately this is increasingly the case, the visualizations are either embedded in a written report or they can be downloaded via the Internet or very likely they are presented by somebody, either the person who prepared the visualization or somebody with a moderator function.

What we tend to neglect is that the words accompanying the visualization, either written or spoken, potentially have a very high influence on the way the visual information is perceived. Especially, in advertisements there is clearly a very strong link between words and visuals. Depending on how words are used, they have the power to inform or confuse an audience.

Besides using words, i.e. in verbal communication, human beings are able to communicate in a variety of ways. This type of communication is referred to as non-verbal communication and includes body language, i.e. gestures, facial expressions, eye contact and movement; but also graphic symbols, art and all sorts of visual expressions, including 3D visualizations.

2 Communicating

2.1 A General Communication Model

The sender/receiver model that we all have already seen somewhere is a widely accepted model for communication in general. It is not a model that was developed having 3D-visualizations in mind. It is a model from Bell Labs for showing how communication within a telecommunication environment works (see SHANNON & WEAVER, 1949) and was developed at a time when digital 3D-visualization did not exist.

Since then, the basic principles have been adapted to communication theory in general and this model even seems to work very well in relation to 3D-Visualizations and for many other specific types of communication (Fig. 1).

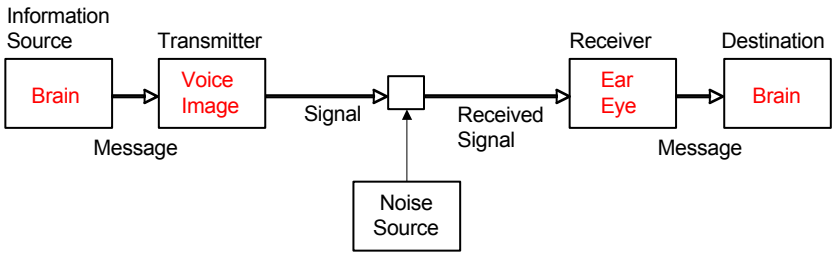

Fig. 1: A general communication model (SHANNON & WEAVER, 1949)

Translating this to the world of planning and design on the one side of the communication process we have the physical environment that surrounds us and that is somehow measurable somehow and on the other side of the communication process we have the receiver, or in other words, the person who perceives.

In this process, the medium can play a key role in how we perceive our environment. In those cases where we are not directly in the environment and sadly enough this is how planners and designers normally interact with their environment, the medium becomes very important.

The major difference that comes into play when we look at how landscapes are perceived compared with the communication process as originally developed, is that this is not just a problem of technology, meaning one signal sent on the one side of the process will normally arrive exactly the same on the other side. Humans however, when they receive the signal, nterpret the signals (i.e. words, graphics, 3D-visualisations, etc.) in a sometimes very subjective way.

2.2 Verbal vs. Visual

Even when a signal is communicated and received properly, sometimes what is communicated does note mean much to the receiver (Fig. 2).

Fig. 2: When being ‘visual’ does not help – at least for most Westerners

An extreme example is the difference in representation between Japanese Kanji letters and an identical word with the same meaning in Arabic letters. Typical Westerners are simply *lost in translation.*

There is an important difference between verbal and visual expression. If you take for example the menu in a restaurant, by just reading the words it is sometimes difficult to find out whether this would be a 3 star Michelin guide menu or a menu from an ordinary university canteen, the words could be rather similar. On the other hand, by looking at what is meant by those words, one could easily detect the difference.

Taking an example from planning in the wider sense, a pattern (a certain hatching, symbols for slopes) or an array of lines (outline of an island, coastline) might mean something to some people but most likely will not mean anything to other people. This touches upon what is referred to as the expert-lay person paradigm. Experts from a given field will perhaps look at something that is represented in expert "language" quite differently than a lay person.

This leads to the problem of abstraction (Fig. 3). We as planners and designers make abstractions of the real world in order to communicate with other experts or with the public.

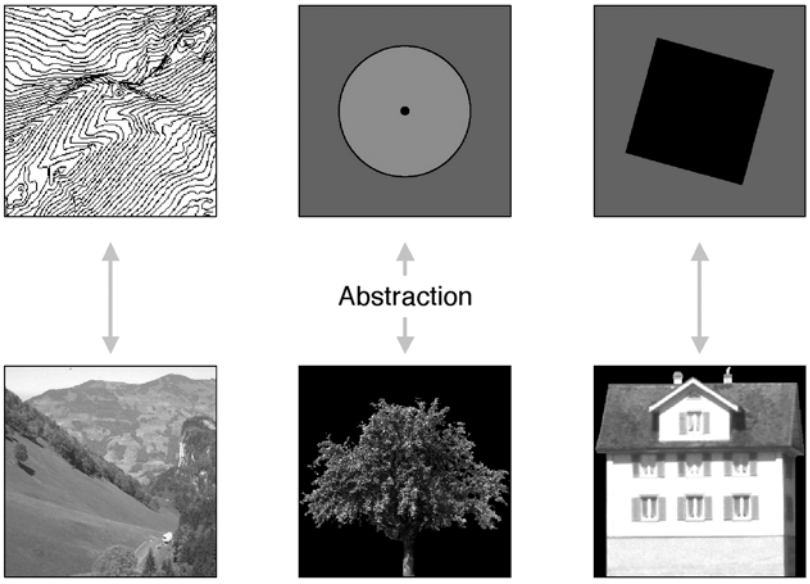

Fig. 3: Abstracting the real world

These abstractions are still mostly expressed in 2D-format, i.e. a characteristic old oak tree as well as a young apple tree might both be represented as a simple green circle. A skyscraper or a small farm house can become black squares on a map and even the most

dramatic terrain will be represented as a comparatively unspectacular set of contour lines. But we have to be aware that even 3D-visualizations are abstractions of the real world, despite having the potential to possess a much higher degree of realism.

3 Communicating with Visualizations

We perceive our environment through a system of senses. Although there is some discussion on the actual number of senses involved (see e.g. HAJOS, 1972; THIEL, 1980), commonly an auditive system (the sense of hearing), a tactile system (the sense of touch), an olfactory system (the sense of smell), a gustatory system (the sense of taste) and a visual system (the visual sense) are distinguished. In addition, a kinaesthetic system (the ability to sense and coordinate movement) and a vestibulary system (the sense of balance) play an important role in perceiving our environment. By far, the most dominant component is the visual perception. The USDA FOREST SERVICE (1973) or BRUCE ET AL. (1996) state that more than 80 % of man‘s perception is based on sight. KURZWEIL (1990) claims that the eyes can process 50 Billion bits per second whereas the ears can only process 1 Billion bits per second.

The primary purpose of any graphics and visualization technique is the effective conveyance of information to the user. Visualizations have been used for hundreds of years and are increasingly gaining importance in landscape design, landscape planning and environmental planning through the availability of digital visualization techniques. The current visualization technology enables us to model and visualize natural, rural and urban environments in a highly realistic way.

In the planning disciplines we typically visualize physically visible phenomenae, but we can also visualize abstract and invisible phenomenae. This way we can help raise the awareness of possible consequences resulting from planning even if they are reaching far in to the future (see Tab. 1).

	Visualization Contents
Visible Phenomenae	Changes in Land Use Nature and Density of Buildings Impacts, Changes (e.g. Projects subject to EIA) ...
Invisible Phenomenae	Function and Effect Relationships (e.g. Network of Biotopes) Noise Pollutants (Soil, Water, Air) ...

Tab. 1: Classification of visualizing visible and invisible phenomenae

4 Issues for Research in Landscape Planning and visualization

4.1 (Un-)Certainty and (Pseudo-)Realism

A key approach to overcome the potential communication problem between experts and lay persons (the expert vs. lay person paradigm) is to use communication media that both parties can understand (see LANGE & BISHOP, 2005). Visualizations are generally to be conceived as a medium that can help to overcome this problem.

From a modeling point-of-view, it can be said that a visualization is more realistic when more specific textures and more specific geometry are used in the modeling of the represented objects (e.g. a specific single family house at a specific geographic location; Fig. 4). A typologic representation of this example implies that the single family houses each could be detailed in texture and geometry but each would be alike. In an abstract symbolic representation, the single family house would be a simple volume representing the typical size of this kind of building with a symbolic single color texture map.

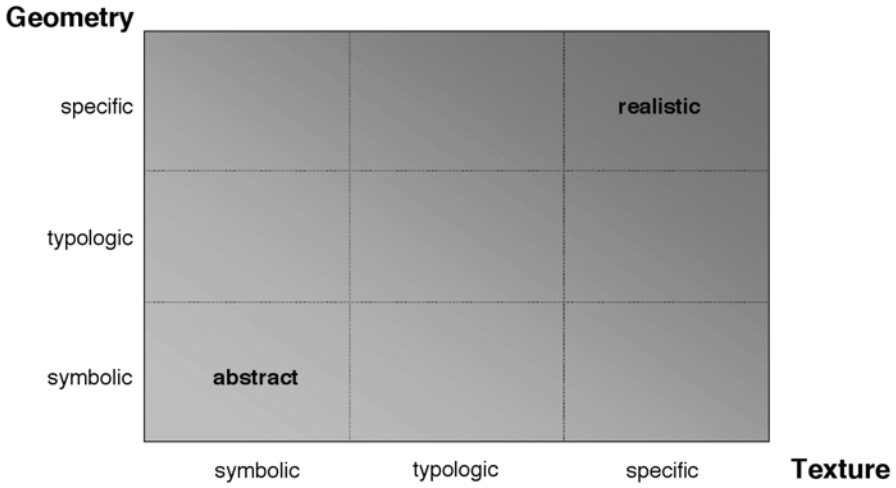

Fig. 4: Abstraction vs. Realism (see DANAHY, 1997)

In essence these issues are a matter of scale. Depending on the viewpoint and on the distance to the viewed object the relative degree of realism and abstraction can change continuously.

Due to the increased capability of available visualization software, virtual landscapes can be produced in a highly realistic fashion. Still, the question remains of how realistic and how detailed a visualization has to be (e.g. LANGE 2001a, APPLETON & LOVETT 2003, PAAR ET AL. 2004, SHEPPARD 2005). Of course, visualizations can be prepared in a highly detailed fashion. It has been pointed out by several authors (e.g. ERVIN, 2001) that the omission of details of the real landscape makes for a certain sterility of virtual landscapes.

Therefore, one could argue, the more realistic the better. This assumption might be true if the base data provides as much detail as the visualization reflects. However, modern visualization tools provide the opportunity to produce highly realistically appearing visualizations on very weak grounds in terms of data precision and consequently might be completely wrong (Fig. 5). There is a certainly a danger that we are raising expectations that cannot be kept. I am still waiting for a law suit where visualizations that promised too much or promised something different, will be questioned in court, including all the potential consequences such as financial compensations.

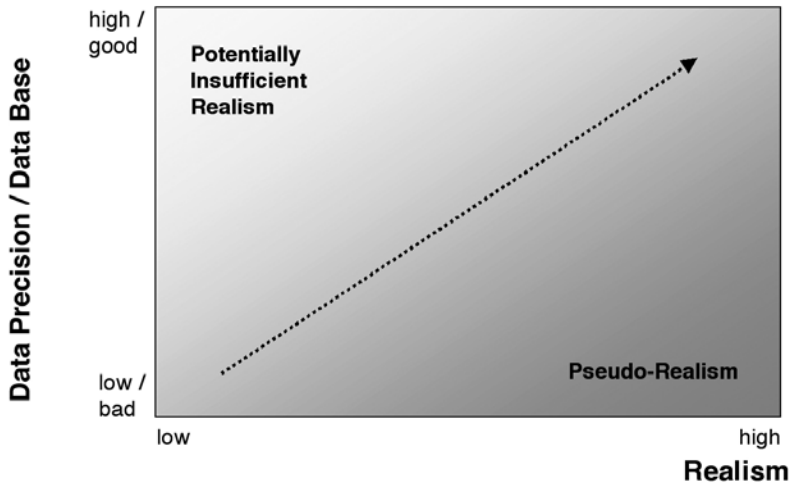

Fig. 5: Data Precision, Realism and Pseudo-Realism

Overall, a visualization should convey enough information that the research questions that have to be phrased beforehand and that need to be answered can be resolved. The future is always uncertain and even if scenario-techniques are applied in planning, the scenarios might contain a high degree of uncertainty. This not only means that visualizations with a lower degree of realism might be appropriate in many cases, but that it even would be wrong to aim for a high degree of realism in those circumstances. In zoning practice, typically only the maximum allowed building volume represented through a certain color or coding, but not details of the building itself, are given. At this stage in planning, more detailed information is normally not available. Therefore, a visualization showing e.g. a specific single-family house with a specific façade instead of an abstract building volume is most likely highly misleading.

Still, there are areas where the representation of landscape elements has a tremendous potential for improvement towards a higher graphical realism. This relates especially to the representation of vegetation structure in the foreground. In detailed areas, especially when the camera is close to ground level, even very high resolution imagery can produce a pixelated foreground effect and individual elements, such as vegetation, may need to be modeled.

4.2 Static Scenes vs. Movement Through a Virtual Landscape

For humans, to move dynamically through a real environment is a normal thing to do. Consequently, moving pictures are a typical reference frame in human perception. DANAHY (2001) stresses the importance of an immersive environment arguing that the 'dynamic qualities of looking around, ... using one's peripheral vision, and focusing with foveal vision on objects of attention are fundamental to a person's visual experience in landscape' (p. 125). Panoramic projections are one option for filling the field of view and generating immersion in the scene. Taking this concept further, it is only consequent to incorporate interactive and immersive possibilities of landscape representation in the process of planning and design of landscapes.

With the Internet developing more and more into an everyday normality, the use of 3D-models (e.g. VRML) in landscape and environmental planning provides easy access to planning concepts expressed in three-dimensional form (NADEAU, 1999; LANGE 2001b) and interested citizens are offered much more than the predetermined viewpoints that are used in reports. They can then view proposals from any viewpoint they like.

Considering the traditional static (print) format, it does make a big difference from where one looks at a landscape and selecting *the* representative viewpoints is always a hot topic for discussion in environmental impact assessment. Consequently, a judgment about changes in the landscape should not be based on just one or two viewpoints. To be able to properly assess proposed changes, several viewpoints, or even better, several landscape sequences have to be considered.

So far, this area remains largely to be discovered in terms of future empirical research. In their study on alternative designs of avalanche dams, BOESCH ET AL. (2001) found indications that animated sequences instead of single static images allow the observer to better differentiate among different alternatives. Also, the results of LANGE ET AL. (2004) in their work on traditional vs. 3D and 4D presentation of design competitions suggest that animated sequences are by far preferred by people in terms of communicating design and planning ideas.

Visualization technology combined with agent-based modeling is a new promising approach that is directed towards the interactive evaluation of sequential experiences in the landscape (CAVENS & LANGE, 2003; CAVENS ET AL., 2003; GLOOR ET AL. 2003). Microscopic modeling of individual hikers coupled with evaluation models (e.g. SHAFER & BRUSH, 1977) allowing the interpretation of images or even 3D representations offers the potential to assess future changes such as vegetation succession or expansion of existing settlements based on landscape metrics and image analysis.

4.3 Participation and Visualization

Methods and techniques for landscape visualization are increasingly used in planning (AL-KODMANY, 1999; BURGASS 2001). Also, in the planning disciplines, participatory methods are currently seeing a revival. So far, typically visualizations in planning are mainly seen as a tool that allows visualizing a certain pre-defined proposal. Visualizations are not seen as

an integrated part of a participatory planning process leading towards a proposal. There are few exceptions to this (e.g. VON HAAREN ET AL., 2002; KUNZE ET AL., 2003; HEHL-LANGE & LANGE, 2005). Some emerging tools allow alternative land development policies to be formulated as maps and through tables. These alternatives are then directly linked with a 3D model for the interactive exploration of scenarios, even with underlying process models (e.g. KWARTLER & BERNARD, 2001; KWARTLER, 2005; STOCK & BISHOP, 2005). Such a visual expression of planning and design could facilitate dialogue between policymakers, planners, designers on the one side and the general public on the other (Fig. 6); this way helping to increase understanding and improve decision-making. Furthermore, "clear communication about environmental protection strategies is especially important for generating enthusiasm and participation and for preventing confusion" (EPA, 2002, p. 15).

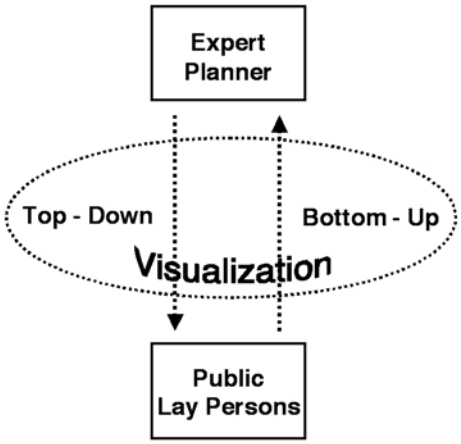

Fig. 6: Visualization as the common ground for communication between expert planners and the public.

Already in the 1970s, physical city models to study design alternatives were jointly used with the stakeholders (e.g. MARKELIN & FAHLE, 1979). Nowadays, computer-based visual simulations can potentially function as the link between the classic top-down approach in planning, i.e. experts providing information to the general public, and the bottom-up approach, i.e. the general public being consulted and participating in decisionmaking.

5 Conclusion and Outlook

Visualizing alternative futures (see STEINITZ ET AL., 2003) on the one hand, and the willingness of the planner to involve the public on the other, could be the common ground for a more sustainable planning that is backed by the public through its continuing involvement. The combination with new visualization technologies has the potential to secure active and imaginative public participation. A participation process integrating

visual representations can be a powerful way of engaging not only local people but also offering benefits for all stakeholders involved in planning decisions.
This way, visualization technology can function as the instrumental basis for a prospective approach supporting the sustainable planning and design of the landscape as it is expressed in Agenda 21. However, when we consider the famous quote of Marshall McLuhan: The medium is the message (coined in an era when TV was still in its infancy), I think that we have to be careful that we are not just concentrating on the visualization technology but rather on the contents that we want to convey by applying visualization technology.

On the other hand, there are many unresolved issues and research questions relating to visualization itself, such as the effect of words (written or spoken) that accompany visualizations, the role of visualizations in a participatory process, the (pseudo-) realistic images that can be produced, even when relying on rather weak data. After all, it might not be just the visual world we should think about, rather the underlying processes that shape our visual world might be just as or even more important to communicate.

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