INFORMATION DESIGN FOR VIRTUAL AND ARTIFICIAL REALITY

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ABSTRACT

The paper describes a biocybernetic approach to information analysis, and information design for emerging high-density 3D communication media such as Virtual and Artificial Realities. The methodology of information design incorporates the latest advances in neuro-cybernetics, artificial intelligence, expert systems and the first guidelines under which the "software" for such systems should be developed. The inherent dangers of information overload, information cascade break-ups and interruptions are pointed to, if the information design is simply transferred from the traditional communication media production routines. In conclusion, 3D audio-visual information design practices over the next decade are discussed.

Key Words: Information design, biocybernetics, virtual reality, artificial reality, 3D media.

Categories:

Artificial Reality/Virtual Reality
Implementation of Virtual Space

Information Design for Virtual and Artificial Reality

Introduction

Humankind's fascination with attempts to create the "third dimension" is nothing new, extending from the pre-history of painting, to the time of early stereoscopes, into the realm of artificial (AR), and virtual realities (VR), which are heralded by the press as the ultimate spatial experience. The notion of 3-D has always given reference to more "realness" or "life-likeness", as human perception functions in a 3-D hodological, spatial mode. Today we seek to heighten our mediated experiences with continued efforts toward perfecting spatial imaging systems. 3-D is the 1990's "buzz-word" even though not all of the "3-D" is factually stereoscopic in nature. 3-D computer graphics abound on TV. 3-D modelling is applied in many technical and scientific fields, 3-D concepts are used in spatial environment design, and 3-D medical imaging presents a "more real" look inside the body. The concept of 3-D has even been extended to encompass the theory of human memory. 3-D as a mode of human thinking is indeed becoming ubiquitous, however it should also be regarded with a certain caution (1). Any media vogue, including the recent focus of attention on virtual reality, might be only a temporary surge unless information design concepts are applied to the software and content side of VR media artworks and productions.

Information Design

The environment of a virtual world can be considered as pure information that the user is able to see, hear and touch (2). The difference is in the design.

The field of "information design" deals with the organization of *information*, which the authors understand in a broader sense as an energetic change with a catalytic characteristic, towards a determined goal and impact using the principles

and theories of biocybernetics, psychophysiology, in combination with communication media production protocols. (3)

Information design as a discipline is a systemic thinking approach resulting in a framework or skeleton of the contents to be expressed via a virtual reality system. The systematizing of such content is the *design*, since the author of the software is using similar creative thinking tools as in writing a novel, composing a musical score, creating a film, video program, or painting a picture. Essentially, we are describing artistic expression here.

The design might stem from the hardware and the accompanying program, whereby the software is really an extension of the machines. It could stem from the requirements of the environment (educational, military, industrial), and then must follow the strict discipline or procedures normal to these environments. It could also stem from the user. In this case, the information design must accept a high level of interactivity and user-friendliness.

There is a substantial difference between technological, psychophysiological and semantic (content related) factors which are responsible for the creation of artificial or virtual reality artpieces, programs or systems, and the factors which are responsible for the creation of a VR media response (information impact) in the viewer/user. What sometimes amounts to a small, or negligible cue from the point of view of the author (virtual or artificial reality designer/creator) may be the paramount reason which causes a high, low, or even non-existent information impact for the people, the receivers, who are perceiving it. Therefore, the scale and importance of the media cues from the viewpoint of the artist, producer, or viewer, and the technological requirements of each VR medium, may result in a different hierarchy entirely. This necessitates an information design approach when employing virtual reality technology in the production of media artworks (4).

The field of *biocybernetics* is concerned with how the human sensory system responds to and processes information, and the resulting impact it has on us. The authors' main focus has been with the individual, either observing or creating the virtual reality mediated program. This is an area of an information process or information chain. The information chain in its simplest scheme, has three parts as described in figure 1.

Each part of a media event, (the program itself, the room and means by which it is perceived, and the person(s) perceiving it, can contain parts of the final information. If any part of the information chain is altered, the information itself is changed. The incoming information acts as a catalyst to other mental processes which occur due to the processing and storage of information in the viewer's brain, and can thus affect the overall impact. As VR media become increasingly more sophisticated and interactive, respect for the information chain and information design of the software/hardware interfaces will be of upmost importance to their success (1, 2).

Information Source →	**Transmission Conditions** →	**Responding Receiver/s**
3DTV, film hologram, VR	room, cinema theater, exhibit	individual, group, audiences

Figure 1: Information Chain Scheme

An information chain exists in a certain time and space. The time of information production and information perception each have a different axis. Production time is very well known in media, (time necessary to produce, organize or structure certain segments or complicated information), as well as transmission

time (the airing time in television, screening time for film). The least known is the perceptual time. It is commonly believed, that the time of transmission or performance should be identical to the time of information perception. Even if it seems to be a common understanding in human communication modes, it is not.

The time differences between information input and information perception are in the millisecond range. In the past, these time segments had little or no meaning. But, with the development of high density information complexes , particularly in virtual realities, perceptual delays can cause high overlaps of information. When one information quantum is processed, the others cannot be processed within the same range or intensities. Even if the short term memory could delay certain quanta, the constantly incoming information becomes more and more overlapped (3).

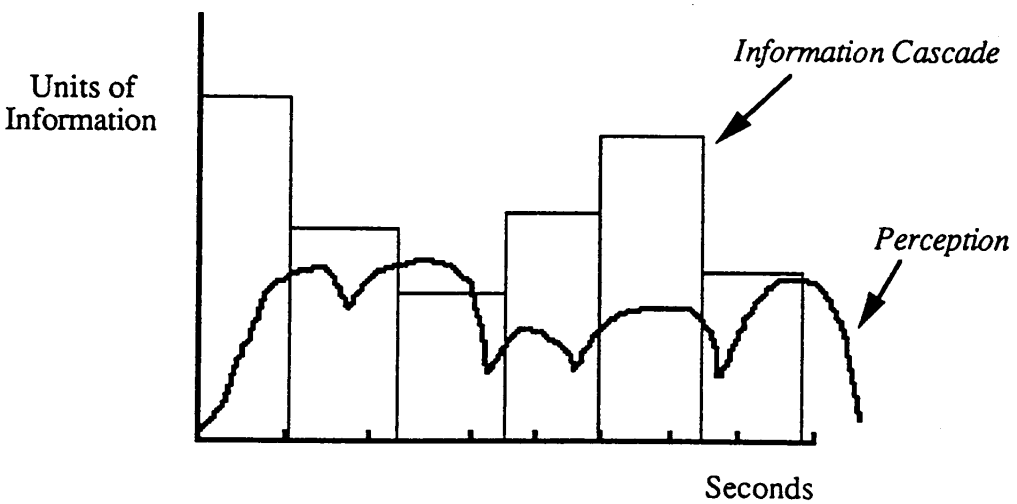

Figure 2. Overlaps in the information Cascade

The overlaps in information processing are typical for an information complex, called an information cascade. There are two different kinds of information cascades. In the first, the receivers (people) have their own freedom to perceive each piece or part of the information complex one after another at their

own pace, (exhibition gallery, book, newspaper). This is called a horizontal, linear cascade. Usually, there is great freedom for the perceiver, not only toward the individual perception time, but also toward the freely chosen succession of pieces.

The second kind of information cascade, called a vertical, structural cascade, is typified by a fixed programmed succession and time for perceiving the pieces of information (film, television program, theater, play, concert). The high overlaps are typical for vertical information cascades. Each piece of information (scene, shot, sequence) is perceived in a period of time called, perceptual time, which varies with different groups of people, in different cities, countries, and time periods. Virtual reality often combines both types of information cascades into a meta-complex of horizontal and vertical components. Therefore, an information design approach for VR can best be compared to the scenographic mode of thinking employed in the creation of a multi-media production (5, 6, 2).

Modelling of the information design

The basic assumption of the authors here, is that the information design for virtual reality must accept the biocybernetic framework of the organisms using it. This calls for the acceptance of the *nature* and the *time-space axis* of the information chain. It also calls for an evaluative procedure of the information domains, bridges and details of the designed software program, and it calls for a certain degree of design of the routines, the procedures by which the user is interactively progressing within the VR program. The last point is a delicate one since it blends the desires of the author-artist to lead the user on a previously determined path, and the desire of the user to freely explore the different views, avenues and niches of the program on his/her own.

In a certain sense, virtual reality systems are copying the mental space of the artwork in general such as when; the VR space designer is imagining while writing

the situation descriptions, the composer is imagining the sounds of his symphony blending from different instruments, the painter is imagining the tonal values of the sky or horizon. This inner mental process can be copied into the virtual reality software, but much less by an intuitive, trial-and-error routine since the VR system can contain many and more numerous routes, trajectories and alternatives. For this reason, evaluation of the information impact of each scene, information domain or detail is not an optional, but a necessary step. What appears to be a luxury for the filmmaker, composer, painter, is for the VR software designer a bare necessity (since the software must be not only attractive, but also a saleable, profitable product). The biocybernetic testing of the VR software modules, materials, visual, and audio segments, provides the author with much of the necessary support during the information design of the software modules (3, 4).

Construction of the information skeletons

The nature of VR software is far from an ordinary book, theatre play, or film, video. It is not a narrative, epic medium. It is absorbed by the user in short, intense time segments, bursts, much like animation film or cartoon serial comics. Each scene is most effective if it lasts only several seconds, up to 1-2 minutes, as the maximal time in the branched linear programming modules. Each interaction with the user has to be within the range of seconds. Even a 2-5 second delay in the interactive routine can bring the desired information impact down to zero. In this way, the VR software and plot can be related to the routines of video games, but certain plot progress could be much more complicated and longer. The interactive routine of the user must lead to unexpected turns, since the element of *surprise* has the greatest possibility to elicit a stress wave (emotional) reaction in the brain of the viewer/participant (3). If, within the given module, there are up to 4-8 such built-in turns (or alternatives), from which the average user will select at least 4, the

program will usually be labelled as attractive, or will be repeated voluntarily by the user.

Each program must begin with an exposé, which has a built-in motivation element. The cascade of the images or the opening view of the situation should contain a poetic (sometimes irrational) element, either in the visual or audio mode, and should involve an initial interactive response from the user. The time from the beginning of the program to the end of the motivation element has to be within the first ten seconds of time (sometime within 2-4 seconds from the beginning of the module). The selection of different routines from the first interaction should begin slowly, with a thinly branched choice of routines (2-3 choices in the first interactive step). Each responsive track has to have a radically different style and content, so that the later routines are not crossed over (the bridges which cross-over, will convince the user of the limitation of such a program). The routines, trajectories of each of the responses should have built-in interactive menus, so that the user will easily acknowledge the virtual environment of each.

The individual steps in the VR software consist of *modules,* each module broken down into *scenes.* A scene (or situation) should be of a duration up to 30-60 seconds, within the 40 second threshold of the short term memory span. Within each scene, there should be up to 10-15 *information domains.* exposed in one individual routine. An information domain can be of the visual (picture) or aural (motive) mode, with heavy alternations. Only once or twice within such a period should the sound and image both be used with a high information density, since information overload could start from the ratio of 4-6 bits/sec. (3). The moveable (changeable) parts of the information domain must have an inner progression (a start with a relatively static, easily recognizable environment and then add moveable parts as soon as the user starts to interact with the image). The peak of the information domain should lie somewhere within the later third of the time

sequence (climax at 60-70% of the time scale), with the last part of the domain in the cool-off period (11).

Within each information domain there are numerous information details (objects, people, beings, etc.) behaving on their own trajectories. Herein lie a number of surprises, the views, with which the user will identify him/herself. It is very important that the VR software have a high level of independence in the way in which the user can manipulate these trajectories. Occasional VR environment interaction can refresh the users attachment to the program. The main importance lies in the information detail of the VR, vis-a-vis the user (a fact well known from video game play).

A specific form within VR software is the *bridge*, or the connecting scene between the modules, or the ends of the scenes. These are the situations, pictures or sound compositions which suggest to the user, new routines, a different program, or the return command. How long the user will play the program, how deeply they will become attached to the particular software, will depend upon the bridges. They could lead to addictive behaviour, or to boredom, or to self-creation of episodes from the program. In any case, the change of form and content which is happening in the bridge must be easily recognizable, and allow for the user's informed decision, to continue or to return to the beginning.

The time axis of the program has to be modifiable by the user, with the perceptual lock (temporal resolution - number of new frames that are generated per second) at the display rate of 60 frames per second. (7). Anything of a higher frequency leads to information skimming which will greatly diminish the attractiveness of the program and the effect of most of the surprises will be lost. To prevent such a loss, it is necessary for the software designers to create trajectories which demand a relative slowness of the replays, either by the definition of the image or sound, or by creating an additional formal or aesthetic surprise niveau

(which will be lost if the program is run at a high speed). At a slower display speed, the human perceptual system will not be convinced of the "reality" and the entire interactive virtual nature of the program becomes questionable by the user (8,9).

Evaluative procedures for VR information design

There are three levels of evaluative procedures that can be used in the information design of virtual realities; the evaluation of the information skeleton (plot testing) and its information hierarchy; the evaluation of individual scenes, information domains, details and bridges; and the evaluation of the interactivity gradient and the user's response modes. The details and extensive methodology for these biocybernetic testing procedures, outlined below, are described in the references (3, 12).

Information skeleton

This evaluation level is similar to film-video script testing, novel synopsis testing, or sketch testing. Here the designer searches for the subject's cerebral responses to the plot trajectories, plot detours, turns and alternative subplots. Positive and negative attitudes, interactivity potentials, and addictive or components which cause unwanted stress for the user, may be discovered during these tests.

Scenes, Domains, Bridges

At this level, the testing should not be carried out on every image or sound used in the program, but only on those about which the authors of the program are uncertain, or which have a questionable or confronting characteristic. Definitely the exposé of the program should be tested in more detail, as well as the climax information domains. The material between should be evaluated only if several variants for the same information domains are available, or if the same visual and aural materials will be presented to radically different audiences, (children,

culturally or ethnically different users/participants). With these tests, the designer can obtain the first indications towards the selection of materials for the branching of the program routines. The hierarchy of these materials could lead to later time sequencing of the scenes and an editing scheme.

Interactivity gradient, response modes

This level of evaluation is carried out when the program is partially assembled and the branching of routines is considered. Here the test subject will interact with the program on a simple mode with partially assembled scenes, and the detail attitude of the user toward the program is tested. The sample should represent as varied a user/participant type as possible.

Virtual reality as a communication arts medium

By the end of the 1980's "virtual reality" was understood to be a surrogate or metaphysical environment created by communications and computing systems (8, 9, 10, 11). The quality of interactivity in communication media began to rise in importance allowing virtual realities to became the media environment of the user/audience through which they can perform their own acts of creative experience.

From the biocybernetic point of view, each artpiece realized as a virtual reality (VR), represents an information complex as described above. However, its parts, (the information source, transmission conditions and the receiver and their response), are heavily loaded on the user/receiver's side. In a classical, traditional art information complex, most of the information load is on the opposite side, (the information source), and is usually the result of the individual author or artist's work. The receiver of the information has little or no power to alter the given syntax and/or form of the information chain.

Within a VR, the consumer of it, (the receiver), becomes an important part of the artpiece and his/her existence within the virtual reality domain is in fact as co-creator of it. The information source does not disappear. It exists on a disk or in computer memory but the information in it becomes specific and different with each different viewer/consumer who interacts with it. In this respect, virtual reality ventures are highly individual, highly private. Such a situation is in contrast with the information society at the end of the 20th century, filled with mass communication media.

For creators of virtual realities it becomes very important to consider some basic guidelines and cues which can effectively serve as their building blocks. These will be far apart from the knowledge of traditional arts such as, painting, music, film, photography or television, even though virtual realities will use parts, excerpts, or compositional structures of the former media. In addition, the creators of virtual realities will not necessarily be established experts in the traditional artistic disciplines. They will tend to be influenced not only by an analog, but heavily by the digital mode of thinking.

It is critical to remember that digital logic and non-biological time sequencing, which are both dominant in writing software, will be clashing with the biological abilities of the VR user. The user/receiver will judge the impact and pleasure of a virtual reality, derived solely from its use by their own human perceptual systems. Therefore, the first basic guideline for the artistic creation of virtual realities is; a respect for the perceptual ramifications of space, tone, distance, x-y-z pictorial coordinates, and divisions according to the basic measures of the human body.

Beginning with pioneering exercises in computer graphics, fractals, and video art, artists found that the most effective shots were those which exerted a single cue, (such as distance, in the endless spiral of Ron Hayes' "Tristan and Isolde" digital graphics piece, or the spatial proportion in Norman McLarren's animated film

"Spheres", or the tonal spectral scale, in Murray Schaffer's composition "World"), into the non-biological domains of digital logic (12).

From the neuropsychologic viewpoint, the exertion of a single cue very often caused a stress wave in the brain's neuronal transfers and could therefore be labelled as "aesthetic surprise" (13). On the other hand, an overload of information on the software side can lead to early fatigue in the viewer unless they are allowed to pace the program to their own biological time frame. This is an attribute that can easily be included in virtual reality programs.

The second guideline applied to VR artpieces, is the accommodation of the user. This process is most important when the author of the software is creating steps, or blocks, through which the user must proceed in order to continue in the program. Although there is an easy analogy with the editing schemes of film or television (film language, television language), virtual reality is a specific field which possesses a facet of multidimensionality. It is here that the story can flow forward or backward, be speeded up or slowed down by the individual user. Time and space can be reshaped, focused, stopped or jumped over - all at the wish of the viewer/user. For such a program to be effective, the creator/author must take into account the possibility of a rich sequencing design, in different directions, times, and proportions. Virtual reality is like a "fluid hologram", which is not frozen in one moment of time but uses it effectively as a multi-dimensional medium.

The third area of creative consideration stems from the fact that VR is a private mind space. Here numerous contents, themes, puzzles, fantasies, etc. can be exploited without any censorship, societal evaluation, moral or ethical ramifications. In this way, VR can be as wild as the user wants it to be, or as gentle and discrete, or as violent, or full of beauty. Since the user does not know in advance where he/she may be led by the progress of the program, it should be monitored via side channels to avoid possible danger to their own mental health.

There is even a serious possibility that more sophisticated VR programs may endanger a person's well being, his/her own thinking patterns or associated motoric and metabolic behaviour without very careful information design.

The fourth area for consideration and potential problems for information design, arises from the fact that VR acts as a powerful catalyzer for associated thinking processes. The person, with their body extended in computer clothing; EyePhone, DataGlove, DataSuit, (14), VIEWstation (15), becomes a synchronized hybrid who will probably eagerly repeat the experiences which were found to be pleasurable or enjoyable. Repetitions of such states may lead to dangerous exhaustion on one side, and to states of uncontrolable behaviour on the other. Such states might also lead to a strong addiction similar to a "drug-like" dependence often exhibited in children who are high users of video arcade games. However, virtual reality as an artpiece, has a strong potential for expansion above the traditional arts media and may eventually consume an enormous amount of time and effort in the life of a twenty-first century person.

Impact of VR on human thinking and values

For the first time, the technology of virtual reality allows media designers to externalize the process of human thought. What was for thousands of years hidden within the realm of the human mind, is now exposed to the laws of digital and analog processing of machines. If a machine can create similar virtual landscapes, environments and clones of human beings - then the impact of such neurotemporary "imagination" will definitely alter human biological thinking and shape the emergence of new human values. On one side, it could have a powerful negative technophobic effect, followed by a syndrome of alienation. On the other side, it may spawn the emergence of hybrids, people who will start to depend upon VR as a necessary addition to their biological life. It may also cause a strong

addiction and damage the information health of a person when overused or misused.

In a number of ways, the information design of VR may complete or substitute the value of silence, value of solitude, the joy of intimate personal and perceptual space, while greatly enhancing the value of informational mobility, and fulfill the values of experimental entertainment and escapism.

Virtual reality may serve as a useful cushion for the conflict between biological/organic time, in which our bodies live, and the informational, non-biological time, in which our daily environment serves us with endless cascades of information.

Even with the potentially positive impact of VR on humans, there could be a heavy price to pay (16). The use of virtual reality systems may cause disorders of the human mind of varying danger to the human body. The temporality of the virtual experience may cause an effect of withdrawal and depression. The enormous dimensions of virtual realities may cause stress and fear, which are both psychically very damaging. When returning back into the real world, the VR user may encounter strong feelings of instability, both physical and psychical, and chaos in both the natural and psychical world.

Conclusion

Virtual realities are important tools within the emerging communication media of the twenty-first century and will continue to evolve in sophistication from the 3-D media technologies of the 1990's. At this early stage, virtual realities are touching the realm of the very private "mindspace" of the user.

With the use of VR technologies, the hyperbole of art is now coming to the very end and very beginning of its own existence. The unknown

artist/hunter from the Lascaux caves who created the first artificial pictures for his own spiritual purpose, comes full circle to merge with the late 20th century viewer-creator, who climbs into his/her own personally created and controlled world of virtual reality.

It would be more than advisable that the information impact of virtual reality match the development of humanistic traditions from artistic media of the past through the careful implementation of information design praxis.

(4250 words)

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