Design of Virtual Reality Exposure Therapy Systems – Task Analysis

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ABSTRACT
Virtual reality can be used to treat phobias, but research in this subject is just beginning. This paper describes a task analysis of the therapy process based on direct observation.

Keywords
Virtual reality, task analysis, exposure therapy, phobias

INTRODUCTION
Phobias are the most common form of anxiety disorders, which themselves are the most common psychiatric disorders. Phobias can often be treated effectively using exposure therapy. This involves subjecting the patient to anxiety-producing stimuli while allowing the anxiety to attenuate. These stimuli have traditionally been generated by presenting the patient with actual physical situations (In Vivo) or by having the patient imagine the stimulus.

Virtual Reality (VR) allows a third option of exposure therapy in a virtual setting that is safer, less embarrassing, and less costly than reproducing the real-world situations and more realistic than imagining the danger.

To bring Virtual Reality Exposure Therapy (VRET) from the experimental lab into the daily practice of the therapist the HCI issues of such systems is being researched at the Delft University of Technology

HCI ISSUES IN VR EXPOSURE THERAPY
There are several reasons which warrant research on the HCI in VRET. First of all, VRET provides a *fully immersive*[1] Virtual Environment (VE) and little is know about the HCI ins such VEs. Second, the UI has to support the collaboration between patient and therapist. In this Computer Supported Collaborative Work (CSCW) the patient is fully immersed, while the therapist is probably not. The therapist will most likely need more control over the VE than the patient, and also need more information about the actions of the patient than visa versa. A third reason is the fact that the VR also serves as an exposure tool; it is not just an interface to the functionality of the system, it is a tool to influence the patient.

HCI in current VRET
To improve the design of the HCI in VRET systems a Task Analysis (TA) should be made of current practice. Since VRET itself is still in an experimental stage, the analysis should also consider other, more developed, processes. Three sources will provide the basis for the TA in this research:

1. *TA of our own experiments through direct observation.* Already a VRET system has been built as a first prototype in this project. Direct observation with the use of video can give the most detailed information on HCI in VRET.
2. *The experimental VRET of other research project.* Other researchers also have some experience in VRET. Through questionnaires their knowledge can be incorporated as well.
3. *Current In Vivo and imaginary therapy practice*. Unfortunately, privacy regulations will most likely be prohibitive for direct observation. Structured interviews with therapist will have to provide the necessary information

TASK ANALYSIS THROUGH DIRECT OBSERVATION
The rest of this paper will describe the TA based on the video recordings of several session in the treatment of fear of heights at the faculty of psychology at the University of Amsterdam. The system uses a Head Mounted Display (HMD) with a 6 degrees of freedom tracking device.

Method
VRET is a highly cooperative process which would require a TA method suited for groupwork, such as Groupware Task Analysis[1] (GTA). Method like GTA are however aimed at more structured processes with many people working with many objects. Applying methods like GTA proved difficult since hardly any physical objects are used and only two persons are involved, while the interaction between these persons is complex.

[1] Fully immersive meaning both eyes and ears are shut of from the outside world and can perceive only the computer generated world.

This complex interaction takes place through several channels, some of these are in the real world and some are communicated using the computer.

Interaction in the real world takes place through talking, but also by physical reactions of the patient.

Interaction using the computer has the form of viewpoint control by the therapist with use of joystick and autopilot or of viewpoint control by the patient with the use the headtracking.

Control of the viewpoint by the patient is continuous and therefore hard to model. It is however possible to distinguish discrete events in the other types of interaction. In all 21 different events were distinguished in the interaction between patient and therapist which cover all relevant interaction. These events can be classified in 7 categories:

1. Verbal instruction by therapist for patient to look or move in a certain direction
2. Verbal questions by the therapist regarding the patient's current fear
3. Verbal explanation by the therapist regarding matters such as therapy rationale or what the patient is seeing
4. Therapist control of viewpoint using autopilot or joystick
5. Verbal and physical indications of the fear experienced by the patient. This indication can be formalized using Subjective Units of Discomfort (SUDs), a scale of 1 to 10 on which the patient must rate his/her fear. The indication can also be involuntarily, such as a gasp, crouching or suddenly clutching the railing.
6. Verbal questions by the patient regarding operation of the system or identification of objects in the VE.
7. Silence was defined as a period of more than 15 seconds in which at the most only viewpoint-control by the patient occurred. (During these silences the patient could often get used to the height and reduce their fear)

Results

During 3 sessions performed by 3 different therapists in 3 different virtual environment the sequence of events was recorded. Analysis showed that evaluating the fear of the patient is the dominant action performed in therapy (see table 1)

1	2	3	4	5	6	7	Total
18	20	10	10	29	2	11	100

Table 1: relative occurrence of the event during therapy in percentages.

When looking at the transitions between the events, the following patterns can be detected (see table 2):

Verbal and physical indications of the fear experienced by the patient are usually preceded by an explicit request by the therapist to do so.

After the therapist has taken control of the viewpoint almost always the patient is instructed to move to or look in a certain direction.

If not distracted by something in the VE, instructions to move or look will often lead to evaluation of the patients fear

Silence is often preceded by an evaluation of the patients fear or the instruction of the therapist to move or look.

	1	2	3	4	5	6	7
1	11	33	8	12	16	16	17
2	0	0	0	0	100	2	0
3	13	4	10	24	0	0	3
4	33	0	5	5	1	0	3
5	33	39	14	3	23	23	31
6	1	0	8	0	1	0	0
7	12	26	7	2	7	1	0

Table 2: Absolute number of times transitions between event occurred during the three sessions. Left are the preceding events and in top the following event.

DISCUSSION

We have attempted to look at the process of VRET by determining the events taking place in real sessions. Analysis of the sequences followed in the therapy shows that, although VRET is a relatively unstructured process, there is a sequence of events which is likely to occur, which can be interpreted as follows:

The therapist will move the patient to a location which might be scary to the patient. It is interesting to note that these locations tend to differ between patients and between therapists, which might suggest that a therapist could have a use for a list of navigation points which can be programmed by the therapist and which can be individualized for each patient.

After moving the patient to a location the therapist will then instruct the patient to look at certain points and evaluate whether the location produced enough anxiety. If so, the therapist will leave the patient in this location, usually accompanied by a long silence, until the fear has habituated.

Ambiguities in the VE can however distract the patient after the patient has been moved to a new location.

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