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Effect of an External Viewpoint on Therapist Performance in Virtual Reality Exposure Therapy

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ABSTRACT
In Virtual Reality Exposure Therapy, therapist are usually only supplied with the same viewpoint of the Virtual Environment (VE) as the patient. This paper investigates the effect of an external viewpoint on the performance of therapists in a VE. Results show that even though this second viewpoint increases the precision with which the therapist can align real and virtual objects, subjects navigate through the VE in a less efficient manner.

Keywords
Virtual Reality, Navigation, Exposure Therapy, Frame of reference

INTRODUCTION
Research has shown Virtual Reality Exposure Therapy (VRET) to be effective in the treatment of several phobias. In VRET, people are treated by exposing them to virtual environments simulating those situations that produce anxiety for them.

To bring VRET from the experimental lab to the daily practice of therapists, we have been investigating the usability of the current state-of-the-art systems. For this, we have already created a task-analysis [2] and are investigating several user interface design alternatives to solve the problem areas we discovered. One problem we encountered is what we call the 'frames-of-reference' problem.

Frames of reference
Current commercially available VRET systems without exception use a Head Mounted Display (HMD) to present the anxiety producing stimuli to the patient. Ideally, this HMD is fitted with a 6 degrees-of-freedom tracker, allowing the patient to move in the Virtual Environment (VE) by walking around in the real world. Unfortunately, limitations such as the limited range of the tracker system and size of the available physical room often lead to the situation where *the space to move about in the VE is bigger than the space available in the real environment.* A one-to-one mapping of the frame of reference of the real world to the frame of reference of the virtual world is not a solution in this situation. One option is to allow the therapist to move one frame of reference relative to the other, e.g. move the patient in the virtual environment through use of a joystick.

A problem encountered with this type of control is that the therapist loses sight of the relationship between the two frames of reference. This can for instance lead the therapist to position the patient too far away from a railing for the patient to be able to walk to that railing and look over it him/herself. This problem is even more serious when there are physical objects that need to be aligned with virtual objects. For instance, in our lab, the patient is surrounded by a railing. To allow the patient to clutch the real railing when looking over a virtual one, the locations of both real and virtual railing need to coincide.

2nd viewpoint

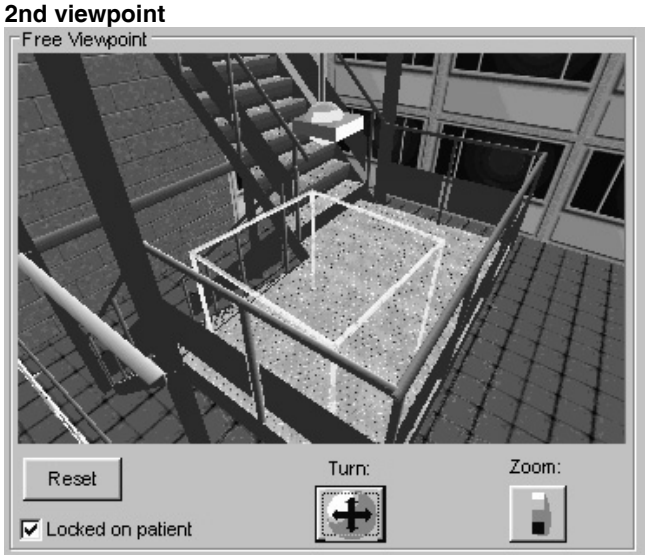

Figure 1: Display of a VE with projections of the patient's head wearing an HMD and the railing surrounding the patient

Current VRET systems are only capable of showing the therapist the exact same viewpoint as the patient. To aid the

therapist in aligning the two frames of reference, we propose the use of a second viewpoint. On this viewpoint we project the location of real world objects. In the case of our setup, this means that the railing surrounding the patient and the HMD are displayed in this second viewpoint as depicted in figure 1. When, on this display, the projection of the real railing and a virtual railing coincide, the patient will experience the illusion that (s)he can touch the virtual railing, hold on to it, and look over it.

This second viewpoint gives the user an exocentric view of the situation. Exocentric views have been known to lead to better global awareness, but can reduce the local awareness needed for efficient navigation [1].

This paper describes an experiment performed to evaluate the effect of having such an external viewpoint on the performance of the therapist.

METHOD

We created a VE with elements typical for phobia treatment: a corridor, a closed elevator and firestairs. Subjects, who took the role of therapists, were instructed to move a patient through the VE as fast as possible using the joystick. At certain pre-defined locations they were asked to place the patient in a position where the patient can look over the virtual railing and press a button when they thought they had reached this position.

There were two conditions, to which each subject was exposed in random order:

1. The therapist could only see the VE from the patient's viewpoint
2. The therapist had two displays: one with patient's viewpoint, one with the external viewpoint described in the previous section.

Subjects

The 'therapists' were 6 persons trained in phobia treatment, 2 of which were professional therapists and 4 psychology students. They had no prior experience with the system, apart from a short instruction that was the same for all subjects. The 'patient' was the experiment leader, and did not move unless instructed by the therapist.

Measures

During the experiment, the following data was collected:

- Total length of the path taken through the VE.
- Total time taken to complete the VE.
- Total length of the path from certain checkpoints in the VE to where the subject pushed the button.
- Total time between checkpoint and pressing the button.
- Total error, which is the difference between the position where the therapist pushed the button and the ideal position. The total error was calculated as a sum of both translation and rotation error.
- Number of times the therapist made a frontal collision with an object in the VE.
- Post-test usability questionnaire with five-point Likert scale questions.

RESULTS

Table 1 shows the results of an ANOVA for repeated measures. The total time taken to complete the VE was significantly higher in condition 2. The total amount of error was significantly lower in condition 2.

On the usability questionnaire (possible scores range from 1 to 5), user reported that, in condition 2, they mostly looked at the second viewpoint (average = 4, SD= 1.095) and that they thought they had a better overview of the situation in condition 2 (average = 4, SD= 1.095).

	F	Significance
Total path length	3.901	0.105
Total time taken	7.070	0.045
Milliseconds until buttonpress	3.946	0.104
Pathlength until buttonpress	2.086	0.208
Total error	6.625	0.050
Number of collisions	0.938	0.377

Table 1: Results of ANOVA for repeated measures, n=6

DISCUSSION

The results suggest that the 2nd viewpoint helps therapists in positioning the patient more precisely, thus aligning the two frames of reference better. The results from the questionnaire also indicate that therapists can have a better overview of the VE thanks to this viewpoint.

However, based on the increase in time taken, we must assume that the second viewpoint also has a negative effect on the efficiency with which the therapist can navigate the patient through the VE. Results of the questionnaire point out that therapists look primarily at the second viewpoint when it is available, and this viewpoint is less suited for the navigation task at hand.

It might be interesting to see how therapists perform after having more experience with the system. Possibly with experience they will be able to select the viewpoint most suitable for the task.

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