Virtual Reality Treatment in Acrophobia: A Comparison with Exposure in Vivo

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Abstract

The aim of the present study was to evaluate the effectiveness of low-budget virtual reality exposure versus exposure in vivo in a within group design in ten individuals suffering from acrophobia. Virtual reality exposure was found to be at least as effective as exposure in vivo on anxiety and avoidance as measured with the Acrophobia Questionnaire (AQ) and even more effective on the Attitude towards Heights Questionnaire (AHQ).

The present study shows that virtual reality exposure can be effective with relatively cheap hardware and software on stand-alone computers currently on the market. Further studies are recommended, in which virtual reality exposure is compared with in vivo exposure in a between group design, thus enabling to investigate the long-term effects of virtual reality treatment.

INTRODUCTION

Virtual reality environments have potential clinical application, especially in he treatment of phobias. Virtual reality integrates real-time computer graphics, body-tracking devices, visual displays, and other sensory input to immerse the phobic patient in a computer-generated virtual environment. Virtual reality exposure has several advantages over exposure in vivo. The treatment can be conducted in the therapist office rather than that therapist and patient have to go outside to do the exposure exercises in real phobic situation and hence treatment may be more cost-effective than therapist-assisted exposure in vivo. Further, virtual reality treatment can also be applied on patients who are too phobic to experience real-life exposure in vivo.

A few case studies have been reported demonstrating the effectiveness of exposure provided by virtual reality. Such case studies have been reported on fear of flying (North, North & Coble, , 1997; Rothbaum, Hodges, Watson,Kessler, & Opdyke, 1996), acrophobia (Rothbaum, Hodges, Kooper, Opdyke, Williford, & North, 1995a), claustrophobia (Botella, Banos, Perpina, Villa, Alcaniz, & Rey, 1998), spider phobia (Carlin, Hofman & Weghorst, 1997) and agoraphobia (Coble, North & North, 1995). To date, only one controlled study has been reported. In this study on college students with fear of heights seven weekly sessions of virtual reality exposure was found to be more effective than no-treatment control (Rothbaum, Hodges, Kooper, Opdyke, Williford, & North, 1995b). Subjects in the no-treatment control group were unchanged.

No study has evaluated the effects of virtual reality exposure versus the effects of other treatments. The effects of exposure in vivo in acrophobia have been well established (Emmelkamp & Felten, 1985). There is a clear need to compare the effectiveness of virtual reality treatment with the effectiveness of exposure in vivo.

In the Rothbaum et al study (1995b), a rather expensive laboratory computer created the virtual environment. However, to be of practical usefulness virtual reality exposure should be shown to be effective on not too expensive personal computers, which are currently on the market.

The aim of the present study was to evaluate the effectiveness of low-budget virtual reality exposure versus exposure in vivo in a within group design in individuals suffering from acrophobia.

METHOD

Design

All patients received two sessions of virtual reality exposure followed by two sessions of exposure in vivo. After an intake session patients received a pretest followed by two sessions of virtual reality exposure. After an intermediate test all patients received two sessions of exposure in vivo. After the last treatment session the posttest was held. Sessions in both treatment blocks lasted approximately one hour and were held twice weekly.

Subjects

Patients were individuals suffering of acrophobia as their main complaint. Patients were recruited by advertisements in local media, offering treatment for acrophobia. Fifteen individuals referred themselves for treatment. Of these 15 individuals 4 were not included in the study, since their fear of heights was not severe enough to justify intensive treatment and one patient declined the treatment offered. The remaining ten subjects (7 females, 3males) signed the informed consent and completed the project.

Treatment

Virtual reality exposure was provided in a dark laboratory room. The virtual worlds were generated using an ordinary Pentium Pro 200 MHz computer with 64 Mb RAM and a Matrox Mystique 220 graphic card running Window 95. The software used was Superscape VRT 5.0, a commonly used VR modeling and visualization toolkit. In all the system was able to generate the display at a rate of about 10 frames per second. The worlds were displayed using the I-glasses from Virtual-IO. This Head Mounted Display has an integrated 3-degrees-of-freedom tracker and does support stereographic projection. (For further technical details see: Schuemie, Bruynzeel, Drost, Brinckman, de Haan, Emmelkamp & van der Mast, 2000). To give the individual an enhanced feeling of height, the patient was standing on a metal grid a few inches above the ground,

surrounded by a railing the user could hold on to. A piece of cloth was placed over the patients' head blinding the subject to all but the virtual world.

During the first session of virtual reality exposure patients were acquainted with the headmounted device and the virtual reality by watching a neutral virtual reality environment (inside of an office) for a few minutes. Then patients were exposed to two different virtual environments which had been especially created for this project: (1) a diving tower and a swimming pool; and (2) a tower building with a glazed elevator (For technical details see Schluemie et al., 2000). Virtual reality exposure was gradual and the therapist gave verbal guidance. Patients had to rate their anxiety level (Subjective Units of Disturbance: SUDS) on regular times during the virtual reality exposure exercises on a 0-8 scale. When the anxiety was diminished the therapist introduced the patient to a more difficult exercise in the virtual world. The therapist, who handled the program by means of the keyboard of a personal computer and a joystick, controlled the virtual reality exposure. The actual world seen by the patient was displayed for the therapist on a video display.

To aid the therapist in deciding whether anxiety had diminished, heart rate was monitored throughout the virtual reality exposure sessions using an ambulatory heart rate device (PPG Hellige compact monitor type SM-152-M). The actual heart rate was displayed continuously on a monitor. Based on reduction in SUDS and heart rate therapists decided to switch to a more difficult exposure scene.

Treatment activities during the *exposure in vivo* condition were held on different locations depending on the needs of the patient and involved climbing a fire escape on a five storied building to reach the landings, going near the edge of a landing and looking down at the ground level. Other exposure exercises involved walking on the balconies of an 18 storied building and looking down at ground level, and walking on the roof of a 5 storied building and looking down at ground level. All patients started in the first exposure in vivo session on the balconies of the 18-store building. Exposure was gradual and the therapist gave verbal guidance. Patients had to rate their anxiety level on regular times during the exposure exercises on a 0-8 scale (SUDS). When the anxiety was diminished the therapist encouraged the patient to do a more difficult exercise. All exposure tasks were performed during the sessions. Neither during the virtual reality exposure, nor during the exposure in vivo phase were patients encouraged to do exposure exercises outside the therapy sessions.

Two advanced clinical psychology students who were supervised by the senior author conducted treatments. The therapists had followed advanced courses in behavior therapy before they were admitted to the therapist team.

ASSESSMENT

The following questionnaires were completed at pretest, intermediate test and posttest. *Acrophobia Questionnaire* (AQ: Cohen, 1977). This questionnaire has two subscales: Anxiety (range 0-120) and avoidance (range 0-60).

Attitude towards Heights Questionnaire (AHQ: Abelson & Curtis, 1989) contains six

questions assessing the attitude towards heights (range 0-60).

Further, subjects completed after each session of virtual reality Exposure *the Fear*

and Presence Questionnaire (Slater, Usah, & Steed, 1994), assessing realism, immersion,

interaction and presence respectively. Results on the technological aspects of this study

are discussed elsewhere (Schluemie et al., 2000).

Finally, at pretest only the Ss completed the *Symptom Checklist* (SCL-90; Derogatis,

1977).

RESULTS

The data were analyzed with MANOVA for repeated measures. Results are presented in

Table 1 and Figure 1.

Insert Table 1 and 2 about here

As shown in table 1, there was a significant time effect on the AQ-anxiety, the AQ-

avoidance and on the ATHQ. Post hoc analyses revealed that both virtual reality as well

as exposure in vivo led to significant improvement on AQ-anxiety. However, virtual

reality exposure led to significant improvement on the AQ-avoidance and ATHQ, but

exposure in vivo did not result in a significant improvement.

To investigate whether severity of psychopathology was associated with improvement bivariate correlations were calculated between SCL-90 scores and improvement on the AQ-anxiety, AQ-avoidance and ATHQ after virtual reality exposure (intermediate test – pretest) and exposure in vivo (posttest – intermediate test) respectively. None of these correlations were significant (p<.05).

DISCUSSION

This is the first study in acrophobia in which the effects of virtual reality exposure were compared with the golden standard of treatment for specific phobias: exposure in vivo. Virtual reality exposure was found to be at least as effective as exposure in vivo on anxiety and avoidance as measured with the AQ and even more effective on attitudes towards heights (AHQ). It should be noted, however, that all patients received virtual reality exposure as first treatment. We did not counterbalance both treatments because we expected a ceiling effect after two sessions of exposure in vivo (e.g. Emmelkamp & Felten, 1985), leaving insufficient room for further improvement with virtual reality exposure. Unexpectedly, this is exactly what may have happened with virtual reality exposure in the present study in a number of patients: Virtual reality exposure as first treatment was already so effective that a ceiling effect occurred thus diminishing the potential effects of exposure in vivo. The positive results of only two sessions of virtual reality with acrophobics from the community in the present study support the earlier

findings of Rothbaum et al. (1995b), who found seven sessions of virtual reality exposure more effective than no treatment control in college students with fear of heights.

As to the process of virtual reality exposure, both SUDs and heart rate data revealed that the results of virtual reality exposure are best explained in terms of habituation. Given the idiosyncratic nature of VR exposure, i.e. the choice and the duration of specific exposure exercises were individually determined, statistical analyses of the SUDs and heart rate data were precluded. Inspection of the SUDS data during virtual reality exposure and exposure in vivo revealed that patients were basically experiencing the same reactions. Typically, both in exposure in vivo and in virtual reality exposure anxiety would first increase and steadily decrease when confronted with a new phobic situation. The same pattern emerged on heart rate data, but heart rate was only monitored during the virtual reality sessions, given the fact that movement would confound the interpretation of heart rate data during exposure in vivo. The overall anxiety level experienced during exposure in vivo, however, was somewhat lower than the anxiety experienced during exposure in vivo.

For ethical reasons, in the present study we used a within group design, since we felt that all patients deserved exposure in vivo, given its demonstrated effectiveness. Given the rather positive results of virtual reality exposure, time seems now ripe to test the comparative effectiveness of virtual reality exposure versus exposure in vivo in a between group design, thus enabling to establish the effects of virtual reality exposure in the long term.

In contrast to previous studies using virtual reality exposure, in which rather expensive VR hardware and software was used, the present study shows that virtual reality exposure can be effective with relatively cheap hardware and software on stand alone computers currently on the market. This suggests that virtual reality exposure will come within reach of the ordinary practitioner within the next few years.

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Table 2. Results of MANOVA

Measures		F	df	P<
AQ-Anxiety	Time-effect	16.8	2	.0000
	Virtual reality	13.78	1	.005
	Exposure in vivo	6.02	1	.037
AQ-Avoidance	Time-effect	10.35	2	.001
	Virtual reality	8.18	1	.019
	Exposure in vivo	1.42	1	.264
ATHQ	Time-effect	7.87	2	.013
	Virtual reality	15.22	1	.004
	Exposure in vivo	1.71	1	.223

Table 1. Means and standard deviations in parentheses of the dependent variables

	pretest	Intermediate test	posttest
AQ-Anxiety	45.7 (22.1)	24.8 (20.1)	18.4 (15.9)
AQ-Avoidance	15.0 (12.6)	7.00 (8.6)	5.4 (7.4)
ATHQ-Attitude	39.0 (15.0)	28.3 (14.7)	24.2 (15.7)