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Virtual Healing: Designing Reality

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Generic virtual reality treatment applied to space-related phobias

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Abstract: Several studies have demonstrated the efficacy of virtual reality (VR) for treating phobias, justifying its use as an alternative to exposure therapy. However, we argue that VR goes beyond in vivo therapy in that it challenges multisensory integration, thereby providing a radically new form of treatment. We recruited 10 patients with space-related phobias to follow a new form of VR therapy. In all cases, samples were homogeneous, presenting one specific phobia. We hypothesized that non-specific VR treatment would be effective, regardless of the phenomenological specificity of the phobia. We propose the use of global desensitization, by means of VR exposure, for agoraphobic, acrophobic and claustrophobic patients. Three types of virtual environments (VEs) were presented to the patients:

− VE devoid of frightening features, to allow the patient to get used to the set up.
− VE containing anxiety-generating features. The chosen VE did not include the situation feared by the patient, but could potentially generate anxiety as it dealt with space (VE non-representative of the main phobia).
− VR representing the main specific phobia (phobia-specific VE). This type of exposure was designed to address the threat-related beliefs and behavior.

Post-treatment evaluations (clinical global improvement, phobia severity, quality of life, handicap, behavioral avoidance, and fear questionnaires) showed an improvement in overall functioning for all measures.

INTRODUCTION

Patients with anxiety disorders show several cognitive and behavioral symptoms. Some types of phobias (acrophobia, claustrophobia and agoraphobia) share a common property: strong sensitivity to space. Patients with anxiety may present with other disorders, especially those related to a vulnerability to sensory conflicts. Several VR-based studies have shown that anxious patients may find multisensory integration difficult (Viaud-Delmon et al., 2000; 2002). We took into account the sensitivity to space and problems with sensory conflicts, and developed a VR protocol addressing both of these issues, as well as the main phobia.

In addition to exposing and desensitizing the patient to anxiety-generating situations, as shown by previous studies (Emmelkamp et al., 2001; Krijn et al., 2004; Botella et al., 1998; Moore et al., 2002), VR challenges multisensory integration (Viaud-Delmon et al., in press). Patients have to cope with different sensory information (visual, auditory, vestibular, proprioceptive) and with the sensory conflict inherent to VR technology (due to the delay in feedback between action and its consequences in VR).

We hypothesized that patients with agoraphobia, claustrophobia and acrophobia would have similar cognitive distortions in the representation of space. Indeed, such patients might find it difficult to construct a coherent representation of spatial dimensions. Patients may experience discomfort (cybersickness) and anxiety in various situations representing different types of space: large or small spaces, open or closed spaces, heights, etc. We therefore used the same therapeutic program for patients with these three space-related phobias.

MATERIALS AND METHODS

Design
All the subjects included in the study underwent one evaluation session and nine sessions of exposure to different virtual environments (VE). Sessions were separated by at least one week. Before and after each session, patients had to complete questionnaires assessing parameters relating to immersion.
Procedure
The first session was devoted to evaluation of the patient and an explanation of the procedure to be followed. Virtual exposure began from the second session. Each session began with fifteen minutes of relaxation, which was then followed by immersion in a VE.

For exposure to the VE, patients were equipped with a head-mounted display coupled with an electromagnetic sensor system. They were immersed in the VE, in which they could move forward by pressing a mouse button. The patients could change direction in the VE by turning around their own vertical axis.

The first set of three sessions was designed to habituate patients to the sensory conflicts inherent to the technique (conflict due to the delay in feedback between action and its consequences in the VE). These conflicts generate cybersickness: symptoms and sensations associated with autonomic arousal (nausea, sweating, heart pounding, etc), vestibular symptoms (dizziness, fainting, etc.), and respiratory symptoms (feeling short of breath, etc). The symptoms of the type generated in response to VR resemble the symptoms of panic experienced by patients confronted with the situation they fear. Such symptoms may arise during therapy, particularly in anxiety-generating environments. These initiation sessions enable the patients to learn to control bodily sensations.

In the next stage of therapy (3 sessions), patients were immersed in a VE containing features that generate anxiety in various space phobias. The chosen environments did not represent the precise situation feared by the patient, but could potentially generate anxiety as they dealt with space. The aim was to treat anxious reactions in situations other than those dreaded.

The final stage (3 sessions) corresponded to more classic progressive exposure to the feared situation. Patients were immersed in a VE representing the main phobia. The main aim was to address threat-related beliefs and behavior. During this stage, the therapist helped the patient to learn adapted cognition and behavior to reduce anxiety in the feared situations. Patients received training in the use of anxiety management strategies (reducing physical symptoms through relaxation, verbalizing their fear, trying to think more objectively). The anxiety of the patients was monitored through both observation and communication. During immersion, after five and fifteen minutes of navigation through the VE, they were asked to rate their level of anxiety on a ten-point scale (Subjective Units of Discomfort Scale, SUDS).

The virtual environments used in this study represented open and closed spaces and heights. Patients had to navigate and locate various landmarks. Involvement in a task increases the patient's capacity to cope with exposure, even in the presence of high levels of anxiety.

Participants
Subjects were recruited from the Psychiatry Department of Pitié-Salpêtrière Hospital in Paris.

Inclusion criteria
A licensed clinical psychologist diagnosed subjects using the Mini-International Neuropsychiatric Interview (MINI; Sheehan et al., 1998), which generates DSM-IV (1994) diagnoses. Only patients aged 18 to 65 years satisfying the DSM-IV criteria for panic disorder with agoraphobia, agoraphobia without history of panic disorder, or specific phobias related to space (acrophobia and claustrophobia) were included.

Patients participated in the protocol on a voluntary basis, and in accordance with ethical guidelines, gave informed consent for participation. The study was approved by the ethics committee of the Pitié-Salpêtrière Hospital, Paris.

Exclusion criteria
The following exclusion criteria were used:

- Principal diagnosis other than the types of anxiety disorder listed above
- Psychotic disorders
- Neurological or mental organic disorder
- Substance abuse or dependence
- Currently receiving another psychotherapeutic intervention
- Subjects on medication meeting the selection criteria were included only if they agreed not to change their medication and not to increase its dose during the study.
Sample
Ten patients met the selection criteria: two later withdrew (one moved away, the other withdrew for personal reasons) and eight patients completed the study. The patients' characteristics are described in Table 1.

Anxiety was measured with the Anxiety Trait Scale (Spielberger et al., 1983)
Depression was measured with the Beck Depression Inventory (Beck & Beamesderfer, 1974)

Measures

Pre-treatment measures
Diagnoses were established with a structured interview (MINI). The level of depression was measured with the Beck Depression Inventory (Beck & Beamesderfer, 1974), and that of anxiety with the Trait Anxiety Inventory (Spielberger et al., 1983).

Pre- and post-treatment measures
Other parameters were evaluated twice, to determine the effects of treatment. These measures included determinations of Clinical Global Impression scale score (Guy, 1976), phobia severity (Cottraux, 1993), handicap and incapacity (Sheehan, 1983), quality of life (Marks, 1993), and behavioral avoidance (Marks, 1985).

During treatment
Anxiety state (STAI-state) was measured before each session, upon arrival at the laboratory and then again after completion of the session. A 22-item cybersickness scale was used after the session to assess the level of discomfort during exposure to VR. This scale consisted of a list of symptoms and sensations associated with autonomic arousal (nausea, sweating, heart pounding), vestibular symptoms (dizziness, fainting), and respiratory symptoms (feeling short of breath). Patients were asked to rate each symptom on a scale of 0 to 4 (absent, weak, moderate, strong).

The presence questionnaire (Schubert et al., 2001) was completed at the end of each exposure session, to assess the level of immersion. Anxiety levels were assessed at the beginning and end of exposure, using the Subjective Units of Distress Scale (SUDS), which give a score of zero to ten. We also evaluated the cognition and emotions of patients during exposure.

Apparatus
We used a V8 head-mounted display (Virtual Research Systems, Santa Clara, CA). The LCD displays had a monocular field of view of 48° by 36°, with an array of 640x480 (true VGA) color triads (pixels) refreshed at a rate of 60 frames per second. The orientation of the subject's

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Table 1: Characteristics of participant

<table>
<thead>
<tr>
<th>Case</th>
<th>Sex</th>
<th>Age</th>
<th>Phobia (type)</th>
<th>Anxiety (STAI-Y-B)</th>
<th>Depression (BDI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient 1</td>
<td>F</td>
<td>26</td>
<td>Claustrophobia</td>
<td>27</td>
<td>2</td>
</tr>
<tr>
<td>Patient 2</td>
<td>F</td>
<td>50</td>
<td>Acrophobia</td>
<td>46</td>
<td>6</td>
</tr>
<tr>
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<td>F</td>
<td>57</td>
<td>Acrophobia</td>
<td>33</td>
<td>4</td>
</tr>
<tr>
<td>Patient 4</td>
<td>F</td>
<td>57</td>
<td>Acrophobia</td>
<td>51</td>
<td>7</td>
</tr>
<tr>
<td>Patient 5</td>
<td>M</td>
<td>37</td>
<td>Claustrophobia</td>
<td>61</td>
<td>29</td>
</tr>
<tr>
<td>Patient 6</td>
<td>M</td>
<td>65</td>
<td>Acrophobia</td>
<td>54</td>
<td>10</td>
</tr>
<tr>
<td>Patient 7</td>
<td>F</td>
<td>57</td>
<td>Agoraphobia</td>
<td>48</td>
<td>6</td>
</tr>
<tr>
<td>Patient 8</td>
<td>F</td>
<td>43</td>
<td>Claustrophobia</td>
<td>47</td>
<td>6</td>
</tr>
</tbody>
</table>
head was determined with an electromagnetic sensor system (Nest of Bird, Ascension) with an update rate of 120 Hz.

RESULTS

As predicted, anxiety reactions were observed even when patients were immersed in environments that did not represent the targeted situation described by the patient (second step of the therapy). SUDS scores were also high in environments dealing with another type of space phobia. For example, patients with agoraphobia experienced anxiety reactions when immersed in a VE dealing with acrophobia. Our results for the more classic exposure to the targeted situation confirmed the efficacy of VR therapy for reducing anxiety.

All scores were lower after exposure to VR (Table 2). The scores for phobia severity and avoidance behavior decreased considerably, providing evidence of a therapeutic effect. In three cases, the patient continued to display avoidance behavior, but nonetheless felt less anxious in the feared situation. The general treatment proposed in this study was therefore beneficial to the patients.

All patients declared that they were able to carry out at least one activity that was impossi-

ble before therapy. For example, one patient with claustrophobia took his wife to the movies. At the end of therapy, one patient with acrophobia went on vacation in the mountains. In addition, patients manifested numerous symptoms of cybersickness during initial exposure, which decreased during treatment, suggesting improvements in the integration of multisensory information delivered by VR.

DISCUSSION

The results concern various subclinical symptoms. Although the situations feared by the patients were very different, all patients found it difficult to cope with different representations of space. This general treatment for space-related anxiety was effective. Participants in this study with various space-related phobias declared themselves more able to face the specific situation in real life. All stages in this therapy had therapeutic effects. The first step in therapy, designed to habituate the patient to VR, made it possible to correct erroneous beliefs and the misinterpretation of bodily sensations (experienced as cybersickness generated by the VR set-up), without visualization of the feared situation. The use of nonspecific environments (step 2) made it possible to treat anxious manifestations independently of the main phobia. This type of exposure was crucial for treating the fear reaction and avoidance in general.

<table>
<thead>
<tr>
<th>Patients (n=10)</th>
<th>CGI (0-7)</th>
<th>Phobia severity (0-8)</th>
<th>Quality of life (0-40)</th>
<th>Handicap (0-30)</th>
<th>Fear Questionnaire (0-120)</th>
<th>Behavioral avoidance (0-4)</th>
<th>Symptons when faced with the feared situation (0-32)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>pre post</td>
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</tr>
<tr>
<td>Patient1</td>
<td>6 2</td>
<td>6 4</td>
<td>9 3</td>
<td>11 6</td>
<td>15 3</td>
<td>2 0</td>
<td>31 20</td>
</tr>
<tr>
<td>Patient2</td>
<td>5 1</td>
<td>8 4</td>
<td>9 8</td>
<td>9 8</td>
<td>25 20</td>
<td>3 0</td>
<td>31 14</td>
</tr>
<tr>
<td>Patient3</td>
<td>5 2</td>
<td>8 2</td>
<td>6 3</td>
<td>6 1</td>
<td>11 5</td>
<td>2 0</td>
<td>31 15</td>
</tr>
<tr>
<td>Patient4</td>
<td>6 1</td>
<td>8 4</td>
<td>22 9</td>
<td>20 12</td>
<td>34 12</td>
<td>2 0</td>
<td>32 18</td>
</tr>
<tr>
<td>Patient5</td>
<td>7 2</td>
<td>8 5</td>
<td>25 15</td>
<td>17 15</td>
<td>34 14</td>
<td>2 2</td>
<td>32 20</td>
</tr>
<tr>
<td>Patient6</td>
<td>7 2</td>
<td>8 5</td>
<td>26 9</td>
<td>16 9</td>
<td>33 16</td>
<td>2 1</td>
<td>32 18</td>
</tr>
<tr>
<td>Patient7</td>
<td>6 2</td>
<td>8 2</td>
<td>24 8</td>
<td>15 4</td>
<td>36 13</td>
<td>1 0</td>
<td>30 19</td>
</tr>
<tr>
<td>Patient8</td>
<td>4 2</td>
<td>6 3</td>
<td>9 3</td>
<td>8 4</td>
<td>23 12</td>
<td>1 1</td>
<td>26 15</td>
</tr>
</tbody>
</table>
Patients were desensitized not only with the avoided situation, but also with other types of situations dealing with space. At the end of the therapy, patients displayed greater self-confidence when exposed to the feared situation. The initial results obtained in this study show improvements in overall state, and particularly in the quality of life of patients with space-related anxiety. Further controlled studies are required to demonstrate the common dimensions of phobias and the generic effects of VR therapy applied to phobias.

REFERENCES


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