



## VIRTUAL REALITY EXPOSURE FOR OCD: IS IT FEASIBLE?

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**Abstract:** Virtual reality exposure therapy (VRET) is receiving increased attention, especially in the fields of anxiety and eating disorders. This study is the first trial examining the utility of VRET from the perspective of OCD patients. Four OCD women assessed the sense of presence, emotional engagement, and reality judgment, and the anxiety and disgust levels they experienced in four scenarios, called the Contaminated Virtual Environment (COVE), in which they had to perform several activities. The COVE scenarios were presented on a Full HD 46" TV connected to a laptop and to a Kinect device. Results indicate that the COVE scenarios generated a good sense of presence. The anxiety and disgust levels increased as the virtual contamination increased, and the anxiety produced was related to the emotional engagement and sense of presence.

**Keywords:** Virtual reality; virtual exposure therapy; obsessive-compulsive disorder; contaminated virtual environment; anxiety disorders.

*Exposición mediante realidad virtual para el TOC: ¿Es factible?*

**Resumen:** La Exposición mediante Realidad Virtual (ERV) está recibiendo una atención cada vez mayor, especialmente para los trastornos de ansiedad y los alimentarios. Este estudio es el primer ensayo que evalúa la utilidad de la ERV desde la propia perspectiva de pacientes con Trastorno Obsesivo-Compulsivo (TOC). Cuatro mujeres con TOC evaluaron la sensación de presencia, implicación emocional, el juicio de realidad, y los niveles de ansiedad y asco que experimentaban en cuatro escenarios virtuales, que denominamos Entorno Virtual Contaminado (EVCO), en los que debían realizar varias actividades. Los escenarios se presentaron en una TV Full HD de 46", conectada a un ordenador y a un dispositivo Kinect. Los resultados indican que EVCO produjo una buena sensación de presencia. Los niveles de ansiedad y asco aumentaron a medida que aumentaba la «contaminación» de los escenarios, y la ansiedad se asoció con la sensación de presencia y la implicación emocional.

**Palabras clave:** Realidad virtual; terapia de exposición virtual; trastorno obsesivo-compulsivo; entorno virtual contaminado; trastornos de ansiedad.

### INTRODUCTION

Cognitive-Behaviour Therapy is the empirically established therapy of choice for Obses-

sive-Compulsive Disorder (OCD) (e.g., Abramowitz, 1997; American Psychiatric Association, 2007; NICE, 2005), and exposure and response prevention (ERP) is an essential treatment component. Nonetheless, published controlled studies and meta-analyses report that nearly 50% of patients do not respond to CBT as expected, even when pharmacotherapy is added (Cottraux, Bouvard, & Millierey, 2005; Eddy, Dutra, Bradley, & Westen, 2004; Leonard et al., 1993; Stanley & Turner, 1995). A large percentage of non-responders refuse or drop out of ERP (near 20%), do not reach clinically sig-

Recibido: 9 diciembre 2013; aceptado 15 enero 2014.

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*Acknowledgments:* This study was supported by the Generalitat Valenciana (Spain), Grant PROMETEO2013/066, and by the Spanish Ministerio de Investigación, Ciencia e Innovación, Grant PSI2010-18340.

nificant improvement (near 25%), or relapse at follow-up. Experts in OCD treatment indicate that the failures observed with CBT may be due to difficulties some patients have in becoming sufficiently engaged in ERP, including the reluctance to participate in self-exposure, along with the intensive ERP regimen that restrict its application in clinical service settings (Abramowitz, Foa, & Franklin, 2003). Other reasons for CBT failures might be the inappropriate delivery of this procedure, if it follows overly-rigid or inflexible treatment protocols that do not allow an individualized approach to the special requirements of each patient (Sookman & Steketee, 2010; Whittal, Thordarson, & McLean, 2005).

The findings cited above indicate the need to increase patients' engagement in and adherence to ERP. One way to achieve this would be through the use of computer-aided treatments. The first computer program for OCD patients with checking symptoms was designed by Baer, Minichiello and Jenike (1987) and later developed by Marks et al. (1998) in the «Behaviour Therapy-Steps» (BT-STEPS) program. The BT-STEPS worked as an automated speech-dialogue system over the telephone, with no face-to-face contact with the therapist. The first two steps were devoted to self-assessment. Next, the patient engaged in a 10-week treatment phase, which included ERP (information, preparation, and guidance through self-treatment). Later on, Clark, Kirkby, Daniels, and Marks (1998) developed an interactive computer program for vicarious ERP, designed to model the self-exposure process for OCD patients. Participants were asked to empathize with a figure from the computer program with contamination and washing symptoms («imagine you are the person on the screen») and learn the principles of ERP by guiding this figure through a virtual exposure to dirt.

The utility and efficacy of BT-STEPS and other computerized programs in treating OCD have been assessed in several studies, and their results have been analysed and summarized in two recent publications (Herbst et al., 2012; Lind Boschen, & Morrisey 2013). The authors of these reviews conclude that the computerized therapy modality represented by BT-STEPS might be

better as an adjunct to clinician-guided therapy than as a stand-alone treatment. Moreover, other factors, such as the lack of face-to-face therapist contact, the low flexibility of computerized programs, and the high comorbidity usually shown by OCD patients, represent a source of limitations to the efficacy of these treatments. Nonetheless, Herbst et al. (2012) also indicate that computerized programs like BT-STEPS can be useful, especially for patients with difficulties in accessing trained therapists.

A more advanced interactive modality of computerized treatment is Virtual Reality (VR). In VR, subjects are invited to immerse themselves in a computer-generated virtual environment that integrates real-time computer graphics, different devices for body tracking, visual displays, and other sensory input devices to increase individuals' «sense of presence», usually defined as «the sense of being there» (Steuer, 1992) or the «feeling of being in a world that exists outside the self» (Riva et al., 2007; Riva, Waterworth, & Waterworth, 2004). The sense of presence is an essential component of VR, since it implies that subjects feel like they are living in a world that exists «here and now», and it opens up the possibility of interacting with this world as in the non-virtual world. From this perspective, one possible advantage of VR in OCD treatment is that ERP can be applied in a virtual world that is perceived as safer than the non-virtual world, but just as real. In this case, VR might be helpful in training the patient to experience anxiety when confronted with the feared stimuli and situations in a secure environment, thus facilitating his/her exposure to real stimuli and/or situations in daily life. An additional advantage of VR is the possibility of recreating scenarios where the presence of a therapist would be difficult, like the patient's bathroom or kitchen.

VR Exposure Therapy (VRET) is increasingly being used in the treatment of different anxiety disorders, such as Claustrophobia (Botella, Baños, Villa, Perpiñá, & Garcia-Palacios, 2000), Agoraphobia (Botella et al., 2007), Acrophobia (Emmelkamp, Bruynzeel, Drost, & van der Mast, 2001; Emmelkamp et al., 2002), Social phobia (Anderson, Rothbaum, & Hodges, 2003), Panic disorder with agoraphobia (Vincelli et al.,

2003), and Post traumatic stress Disorder (López-Soler, Castro, Alcántara, & Botella, 2011; Rothbaum et al., 2001), among others. Although there are few controlled and randomized studies and the number of treated subjects is still small, the results obtained to date suggest that VRET is a promising tool to provide ERP to individuals with anxiety disorders (Krijn, Emmelkamp, Olafsson, & Biemond, 2004). For example, a recent randomized controlled trial applying VRET for Social Anxiety Disorder was shown to be equally as efficacious at a one-year follow-up as exposure group therapy (Anderson et al., 2013). Nonetheless, as far as we know, there are no published studies about the possibility of applying ERP to OCD patients using VR, although there are some interesting computer-based trials to assess checking symptoms (Kim et al., 2010).

Our main objective was to explore the possibility of VR as a new tool for applying ERP to OCD patients with contamination/washing symptoms. The specific aims were: first, to examine the usability, sense of presence, and reality judgement of a Contaminated Virtual Environment (COVE); second, to ascertain to what extent COVE provokes anxiety and disgust in OCD patients and, based on this, its potential utility as a complementary tool to in vivo ERP; and third, to analyse the relationships between the sense of presence and reality judgement about COVE and the anxiety and

disgust experienced by OCDs when exposed to COVE.

Moreover, in designing the study we posited some additional requirements so that practitioners in their routine clinical practice could easily apply the new tool. From this perspective, regarding hardware, we wanted it to be easy to use, available to clinicians and patients, and easy to install, set-up and transport. As for the software, it had to be easily tailored to the characteristics and needs of each individual patient.

## METHOD

### *Participants*

The study participants were 4 women with a main Axis I OCD diagnosis (DSM-VI-R criteria, APA 2000) and contamination and washing symptoms as their main symptom dimension. The patients' demographic and clinical characteristics are displayed in Table 1. Patients #1 and #2 attended the OCD Research and Treatment Unit at the University to receive a structured Cognitive Behavioural Treatment (CBT) program for OCD. At the time of the study, Patient #1 was at the 3-month follow-up after CBT, whereas Patient #2 was relapsed two years after successful Cognitive Therapy. This patient did not receive ERP because she refused to engage

Table 1. Demographic and clinical data of participants

<i>Variables</i>	<i>Patient # 1</i>	<i>Patient # 2</i>	<i>Patient # 3</i>	<i>Patient # 4</i>
Age (years)	22	42	22	38
Studies	University	Medium	University	Medium
Experience with VR	No	No	No	No
Weekly time playing computer games (0-3)	1	0	1	0
Y-BOCS pre-CBT	20	30	17	21
Y-BOCS current	3	20	6	3
CBT current stage	Follow-up 3 months	Relapse	Post-CBT	Follow-up 3 months
OCD main symptom dimension	Contamination/Washing	Contamination/Washing	Contamination/Washing	Contamination/Washing
Medication (current)	None	None	None	None

*Note.* Y-BOCS: Yale-Brown Obsessive Compulsive Scale; CBT: Cognitive Behaviour Therapy

in self-exposure, either in vivo or in imagination. She was on a waiting list to be included in a new CBT trial. Patients #3 and #4 were attending an outpatient mental health clinic in the Spanish National Health System to receive the same CBT program for OCD as the one offered at the University. Patient #3 was in the relapse prevention stage, and Patient #4 was at the 3-month follow-up. All of them were invited to voluntarily participate in a new way of conducting ERP for washing OCD symptoms. As shown in Table 1, at the beginning of treatment their Y-BOCS scores indicated a moderate or severe OCD, whereas at the study time, only Patient #2 obtained a clinically significant score on the Y-BOCS. None of the patients had a comorbid Axis I disorder or was receiving pharmacotherapy at the time of the study. They were told that we wanted to know their opinion about a new system to provide ERP, and this was the only purpose of the exercise. Nonetheless, we invited them to experience the different situations and scenarios as intensely as possible. None of them had experience with RV, and the time they devoted to playing computer games was none or around two hours per week.

### Assessment

Following the usual procedure in our outpatient clinics, all the potential participants are individually screened with a full history and examination by one of the authors, who also fills in the Y-BOCS and informs the subject about the study's purpose and assessment procedure. After giving his/her explicit consent to participate, the patient is referred to a therapist (one of the authors) who completes the OCD assessment in a two-hour session using the SCID I Interview (First et al., 2002). This is an interview for making the major DSM-IV-TR (APA, 2000) Axis I diagnoses. The participants also complete several self-report measures on OCD symptoms, depression, anxiety, worry proneness, dysfunctional beliefs and thought control strategies. However, based on the aims of this study, only the results from the Y-BOCS and the self-report to assess the sense of presence and quality of the software described below are

reported. The study has received the approval of the Ethics Committee of the University.

*Reality Judgement and Presence Questionnaire* (RJPQ; Baños et al., 2000). This is a post-test subjective measure assessing presence and reality judgment. It consists of 56 self-report items (Likert scales from 0: not at all to 10: absolutely) with 6 factors: Emotional involvement; Reality Judgment and Presence; Interaction and external correspondence; Quality and easy of use of the Software; Satisfaction with the experience; and Attention required. This questionnaire has been developed and validated in Spanish samples, obtaining Cronbach's  $\alpha$  values  $\geq 0.82$ .

*Visual Analogue Scales* (VAS) on the anxiety and disgust experienced during the four action sets were also used. Participants were asked to rate, on a 1-10 point Likert scale (1 = Not feeling the emotion at all, 10 = Feeling the emotion intensely), how much anxiety and disgust they felt at each moment. The participants could observe their ratings, given that two virtual thermometers, one for anxiety and the other for disgust, were placed at two corners of the TV screen.

### Hardware and software devices

VRET was provided in the room that is usually used as the clinical setting in the University. The hardware consisted of a Full HD 46" TV, a laptop, and a Kinect for Windows machine connecting the TV to the laptop. The individual faces the TV and sees herself inside the TV. The Kinect device enables users to communicate naturally with computers simply by gesturing or speaking.

The software (COVE) was specially designed to be captured by the Kinect machine and it consists of four sets of different activities that the patient must do in the same scenario: a clean and tidy kitchen, which includes a tap that the therapist can turn on or off to instigate or prevent washing impulses.

The therapist guides the patient through the four sets of activities, indicating what must be done moment-by-moment. In this way, the therapist can adapt the narrative to the patient's specific situation, modulating the intensity of over-exposure by adapting the narrative to his/

her reactions and needs. The four sets of activities are designed to progressively increase the level of contamination and/or dirtiness in the kitchen. Prior to being engaged in the Virtual Exposure task, participants practice the same movements that will be performed later in the virtual kitchen, but in a neutral scenario at an office desk. For instance, the subject is asked to take a book from a shelf and then leave it on the table using the same hand. These movements can be repeated until the subject feels confident enough about the requested actions. The actions to be performed by participants in the four consecutive activity sets are, briefly, as follows. In the first set, the subject must take out a head of lettuce that is next to a loaf of French bread inside a supermarket bag. The bag is next to an uncovered chicken. Then, without cleaning the lettuce, she/he is asked to open the fridge and put the lettuce on a shelf that is above an uncovered piece of cake. Next, the subject must take the uncovered piece of cake and taste it. In the second set, the subject is asked to take a dirty cleaning cloth and clean a bench with it. After doing so, he/she must take the French bread, put it on the bench, take a knife that is on the unclean bench, cut a piece of bread and eat it. In the third activity set, the knife is on top of the dirty cleaning cloth. The subject is asked to take an apple that is next to the uncovered chicken. Then, he/she must cut the apple into two pieces with the knife and eat each apple piece. Finally, in the fourth set, the patient is asked to take an open bottle of orange juice that is inside the dustbin, and then take a glass, fill it with orange juice, and drink it. All the individual actions in each activity set must be done using the same hand. After each action, the patient is asked to indicate his/her levels of anxiety and disgust on scales from 1-10; thus, each action can be repeated until the anxiety and disgust levels decrease or disappear. The VRET sessions of the participants in this study were fully video-recorded.

## RESULTS

The data from the RJPQ indicate that the COVE was able to induce a reasonably strong

sense of presence in the patients, as all the scores on Reality Judgement & Presence and Interaction & external correspondence subscales were above 6 points. Moreover, the virtual scenarios did not produce negative effects in any of the patients, as the scores on quality of the software and satisfaction with the experience subscales are  $\geq 6$ . When the results are examined separately for each patient (Figure 1), the poorest effects were observed in the two older patients. In fact, Patient #2 showed the lowest scores on emotional involvement and sense of presence, which indicates that she engaged poorly with the virtual experience, even though she rated the software as realistic.

Our second objective was to ascertain to what extent COVE was able to induce anxiety and disgust and, based on this, its potential usefulness as a VRET. Figure 2 shows the mean scores obtained by the patients on the four action sets. As can be observed, the anxiety and, especially, the disgust levels increased significantly as the potential dirtiness and contamination increased through the four sets of actions.

Regarding the relationships between sense of presence, reality judgement, and the anxiety and disgust experienced during the performance of the COVE tasks, results suggest that anxiety but not disgust, is associated with the emotional engagement ( $r_{xy} = .87; p \geq .05$ ) and sense of presence ( $r_{xy} = .88; p \geq .05$ ) experienced during the virtual exposure.

## DISCUSSION

The use of the so-called new technologies in the treatment of mental disorders is attracting increasing interest, both in research and clinical practice. The development of VR procedures to disseminate the application of ERP to anxiety disorders is especially interesting, since ERP is the essential component in most of the efficacious treatments for those disorders.

The present study aimed to examine the feasibility of developing and applying VRET to OCD patients, keeping in mind that, as far as we know, this possibility has not yet been explored. To reach this objective, the first step

was to ascertain the extent to which VRET was experienced by patients as in-depth and «real», that is, whether the VRET was able to induce a

sufficient sense of presence to cause patients to experience the same sensations and emotions they feel when facing situations in daily life

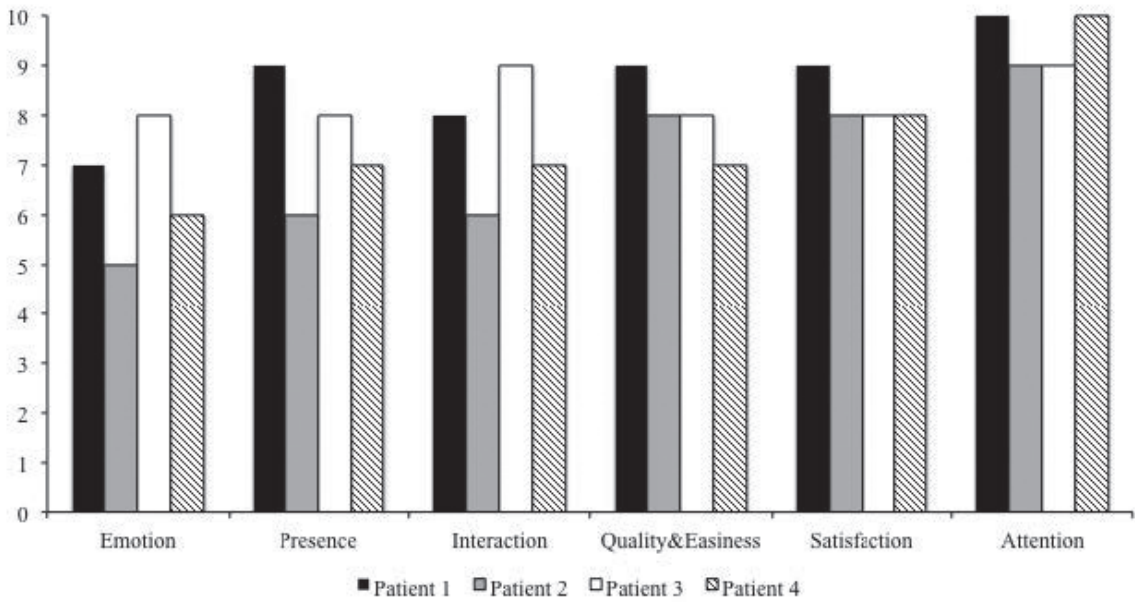


Figure 1. Scores of patients in the Reality Judgement and Presence Questionnaire subscales

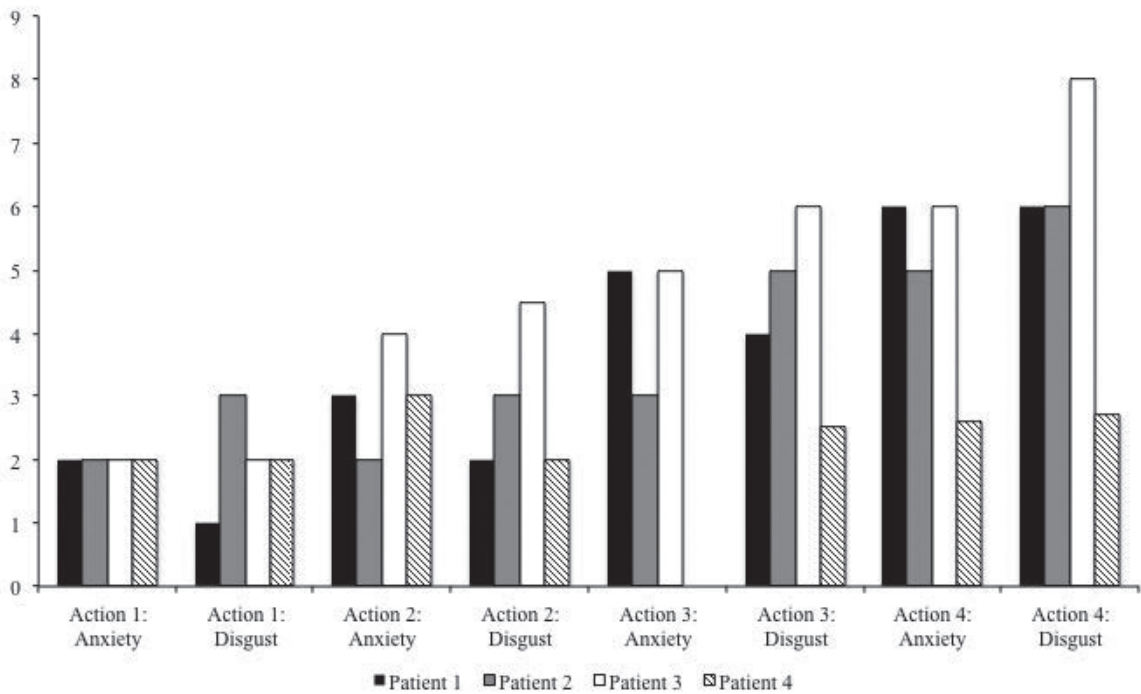


Figure 2. Anxiety and Disgust scores of patients on the four action sets

that give rise to their symptoms. Our results indicate that the virtual context, COVE, produces a reasonably high level of sense of presence, especially regarding the naturalness of the environment. Moreover, this virtual environment was evaluated as easy to use, it generated a naturalistic interaction, and it was experienced as more real than artificial. It is noteworthy that the anxiety and disgust levels experienced by patients increased as the virtual contamination increased, and that the anxiety produced by the exposure was related to the emotional engagement and sense of presence experienced in COVE.

Another important aspect in considering the clinical utility of VRET is the level of acceptance by OCD patients, given that a large percentage refuses ERP or have difficulties in engaging adequately with the procedure (Sookman & Steketee, 2010). Results from VRET studies suggest that patients usually accept the use of VR well. Garcia-Palacios, Botella, Hoffman, and Fabregat (2007) compared the acceptance of one-session and multi-session in vivo exposure to multi-session VRET for specific phobias. The authors found that more than 80% of the sample preferred VRET to in vivo exposure. Although we have not explored this specifically, our data indicate that the four patients were highly satisfied after the trial session. Results also indicate that age has a negative impact on reality judgement, emotional engagement, and sense of presence. These are important aspects that must be further explored, since they could be an important limitation in applying VRET to older patients who lack experience with the use of new technologies.

Nonetheless, we are aware that this first trial provides an introduction to a new way to offer ERP to OCD patients using new technologies. In this sense, our results, although promising, must be interpreted with caution. It is necessary to apply COVE to more patients and in more sessions, design more actions and scenarios, and explore more in depth whether COVE can be used to facilitate patients' adherence to in vivo ERP, or even have comparable efficacy to ERP on a regular treatment-session basis.

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