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Editors:
Brenda K. Wiederhold, PhD, MBA, BCIA
Giuseppe Riva, PhD, MS, MA
Alex H. Bullinger, MD, MBA

Interactive Media Institute

Original Research

Assessment of Emotional Reactivity Produced by Exposure to Virtual Environments in Patients with Eating Disorder

M. Ferrer-Garcia & J. Gutiérrez Maldonado, PhD.

University of Barcelona

Abstract: *This paper describes the effectiveness of virtual environments to elicit emotional responses in eating disordered patients. This study is part of a wider research project analysing the influence of the situation to which subjects are exposed on their performance on body image estimation tasks.*

Though it seems self-evident that there is a close relation between eating disorders (ED) and altered body image, in the literature on the subject no clear association has in fact been established, and indeed the results of the studies are often contradictory or inconclusive. A number of hypotheses have been proposed to account for these results. Some authors have stressed the fact that body image may be to a certain extent more a state than a trait and may change according to situational or emotional variables. Several studies have analysed the possible impact of exposure to specific objects or situations on the stability of the body image.

In this study we designed several virtual environments that were emotionally significant for subjects with ED in order to generate different levels of anxiety and variations in mood. Unlike conventional methods (real exposure to the situation, exposure to photographs, exposure via guided imagination, and so on), virtual reality exposes subjects to interactive three-dimensional environments that simulate real situation. These environments have ecological validity but also permit strict control over the variables and the recording of data. Virtual reality offers many of the advantages of the conventional methods mentioned above, and also overcomes many of their drawbacks.

Thirty female patients with eating disorders were exposed to six virtual environments: a living-room (neutral situation), a kitchen with high-calorie food, a kitchen with low-calorie food, a restaurant with high-calorie food, a restaurant with low-calorie food, and a swimming-pool. After exposure to each environment the STAI-S (a measurement of state anxiety) and the CDB (a measurement of depression) were administered to all subjects.

The results showed significantly higher levels of state anxiety in the kitchen with high-calorie food ($F=13.120$; $p = 0.001$), the restaurant with high-calorie food ($F = 14, 954$; $p = 0.001$) and the swimming-pool ($F = 4.230$; $p = 0.049$) than in the neutral environment. Analysing the scores for depression obtained on the CDB, significant differences again appeared between the high-calorie food environments ($F = 7.187$; $p = 0.012$ in the kitchen and $F = 5.933$; $p = 0.021$ in the restaurant) and the neutral environment. In the high-calorie food situations patients with ED showed a more depressed mood.

Virtual reality thus appears to be a valid instrument particularly useful for simulating everyday situations that may provoke emotional reactions such as anxiety and depression, in patients with ED. Virtual environments in which subjects are obliged to ingest high-calorie food provoke the highest levels of state anxiety and depression. Previous studies have shown the capacity of VR to elicit states of anxiety in patients with other pathologies too.

INTRODUCTION

During the last four decades, body image disturbances have been considered one of the main features of eating disorders. Nevertheless, the published literature has not established a clear association between Eating Disorders (ED) and altered body image, and found results have been often contradictory or inconclusive. [2, 8, 18, 19, 20] In order to explain these results some authors have stressed the fact that body image may be considered more a state than a trait[20,21, 24] and may change according to situational or emotional variables. Several studies have analysed the possible impact of exposure to specific objects or situations on the stability of the body image. [1,3,6,7,9,10] These studies suggest that body image, or some of its components, can indeed be understood as a state.

Following the same research line, we want to study whether exposure to virtual environments produces variations in the estimation of body image and whether anxiety exerts a mediating role in this relation. With this aim, we designed several virtual environments that were emotionally significant for subjects with ED in order to generate different levels of anxiety and variations in mood. This paper describes the first stage of the project, in which we evaluate the effectiveness of these virtual environments to elicit emotional responses in ED patients.

In the area of eating disorders, virtual reality has been used for the assessment and treatment of body image disorders[11-16]. Perpiña and co-workers (1999) compared the efficacy of a traditional body image disorders treatment program with the efficacy of a treatment program that included virtual exposure. Patients treated with virtual reality showed a significantly major recovery in body image disorder and in depressive and anxious sintomathology.

These studies show virtual reality as a valuable technology for psychopathological assessment and treatment. One of the main advantages of this technology is its capability of simulating real situations (high ecological validity) and allowing a severe control of the variables, at the same time. So, virtual reality offers many of the advantages of the conventional methods (real exposure to the situation, exposure to photographs, exposure via guided imagination, and so on), and also overcomes many of their drawbacks.

It is accepted that patients with ED show anxiety on seeing high-calorie food and in situations in which their body is displayed or in which they come into contact with other people[17]. In our design of the environments we incorporated these two variables in the following conditions: Presence of food (No food, high-calorie food and low-calorie food) and presence of other people (No other people present and other people present). The combination of the two variables gives rise to a repeated measures design (2x3) with six experimental conditions or virtual environments: The living-room or neutral environment (no food and no other people present), the kitchen with low-calorie food (low-calorie food and no other people present), the kitchen with high-calorie food (high-calorie food and no other people present), the restaurant with low-calorie food (low-calorie food and other people present), the restaurant with high-calorie food (high-calorie food and other people present) and the swimming-pool (no food and other people present).

This study aims to assess the effectiveness of virtual environments to provoke emotional reactions (anxiety and depressed mood) in patients with ED. The following hypotheses are considered: the first one, if food constitutes an aversive, anxiety-provoking stimulus for people with ED, exposure to virtual situations in which subjects must eat different types of food (high or low calorie) will increase their level of anxiety and depression; the second one, if subjects with ED experience higher levels of stress in social situations and situations that involve scrutiny by others, exposure to these types of situation will increase their level of anxiety and depression.

MATERIALS AND METHODS

Procedure

In a *first stage*, all the subjects of the sample filled two self-report questionnaires, the EDI-2 (Eating Disorders Inventory) and the STAI-T (Trait Anxiety Inventory). Each subject was then measured and weighed individually in order to calculate their body mass index (BMI). The

measurements were performed after the questionnaires were completed to avoid the possible influence on the test scores of anxiety caused by the measuring and weighing. Finally, a form was filled out for each subject specifying their age, weight, height and BMI, type and course of the disorder and severity of symptoms. In a *second stage* the six virtual environments were randomly administered. In the interval between the presentation of each environment, the subject was administered the STAI-S (State Anxiety Inventory) and the CDB (a depression scale). Both tests were computerized using a program that integrates them in the sequence of virtual environments, and records and saves the data.

Subjects

The sample comprised 30 women with a prior diagnosis of eating disorder (17 with anorexia nerviosa, 11 with bulimia nerviosa and 2 with non-specific eating disorder) and with ages ranging from 16 to 32 (mean = 20.57 and standard deviation = 4.15). The patients were from hospital centres and private clinics in Barcelona: the Hospital Germans Tries i Pujol, the Hospital de Sant Juan de Déu, the Clinica Labor and the Centro ABB.

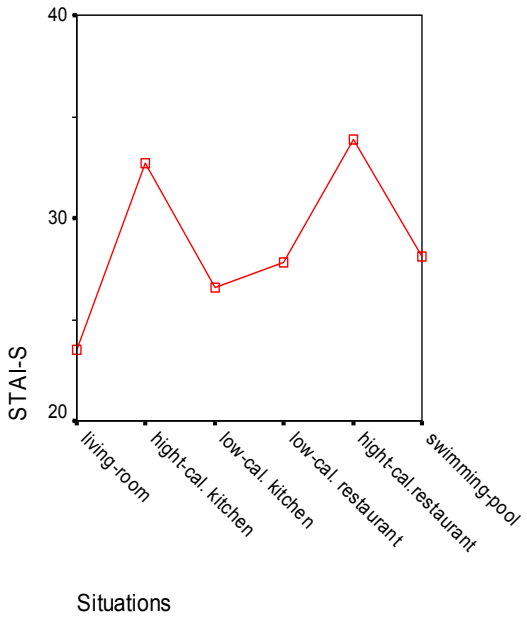

Figure 1. STAI-S scores obtained after visiting each virtual environment

Instruments

EDI-2 *(Eating Disorders Inventory-2)*. D.M. Garner. Spanish adaptation by S. Corral, M. Gonzalez, J. Pereña & N. Seisdedos (1998): self-report questionnaire for the evaluation of symptoms that normally accompany anorexia nervosa and bulimia nervosa. The questionnaire offers scores on 11 scales: Drive for Thinness, Bulimia, Body Dissatisfaction, Ineffectiveness, Perfectionism, Interpersonal Distrust, Interoceptive Awareness, Maturity Fears, Asceticism, Impulse Regulation and Social Insecurity.

STAI *(Stait-Trait Anxiety Inventory)*. C.D. Spielberger, R.L. Gorsuch and R.E. Lushene. Spanish adaptation by N. Seisdedos (1988): anxiety questionnaire comprising two separate self-report scales that measure two independent concepts of anxiety, a) as a state and b) as a trait.

CDB *(The Barcelona Depression Questionnaire)*. J. Gutiérrez-Maldonado and M. Mora-Bello (2000): Self-report instrument for measuring variations in depressed mood. It comprises 23 items, each one with a visual-analog scale with an adjective describing a mood written at the top: subjects mark the line corresponding to their experience of this mood, ranging from “I don’t feel like this at all now” to “I feel completely like this now”. The items were taken from the diagnostic criteria for major depression from the nosological classification of the DSM-IV and were presented in the questionnaire in the same order as the criteria. All the items are formulated in the same direction.

Virtual environments: six virtual environments (living-room, kitchen with low-calorie food, kitchen with high-calorie food, restaurant with low-calorie food, restaurant with high-calorie food, and swimming-pool) developed using the virtual reality software 3d Studio Max5.1 and programmed using the Lingo language with the Director software.

RESULTS

Using repeated measures analysis, we compared subjects’ scores on the STAI-S and the CDB after visiting each of the five experimental environments with the score obtained after visiting the neutral environment (the living-room).

The results showed significantly higher levels of state anxiety in the kitchen with high-calorie food (F=13,120; p = 0,001), the restaurant with high-calorie food (F = 14, 954; p = 0,001) and the swimming-pool (F = 4,230; p = 0,049) than in the neutral environment (figure 1).

Analysing the scores for depression obtained on the CDB, significant differences again appeared between the high-calorie food environments (F = 7.187; p = 0.012 in the kitchen and F = 5.933; p = 0.021 in the restaurant) and the neutral environment. In the high-calorie food situations patients with ED showed a more depressed mood (figure 2).

Finally, no interaction was found between the variables "food" and "people". There were significant differences only on the level of state anxiety (STAI-S) comparing low-calorie and high-calorie food environments (F = 15,262; p = 0,001). No differences were found between environments with people and those without, or when analysing the combined effect of these two variables. The same pattern of results appears on analysing the results of the CDB: the only effect is exerted by food.

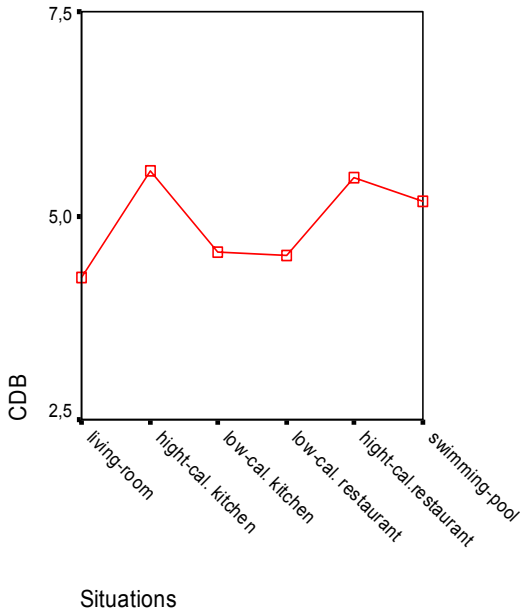

Figure 2. CDB scores obtained after visiting each virtual environment

DISCUSSION

According to the first hypothesis, virtual environments in which subjects have to eat high-calorie food (the kitchen and restaurant with high-calorie food) caused significant increases in the levels of anxiety and more depressed mood compared with the neutral situation (the living-room). Subjects with ED show negative reactivity to high calorie foods due to their fear of gaining weight. Other authors as Heilburn and Flodin (1989) have already stressed the aversive effect that food has on patients with ED.

In reference to the second hypothesis, we aimed to determine whether exposure to virtual environments that simulate social situations increases the level of state anxiety and produce a more depressed mood in people with ED. Only the swimming-pool situation significantly increases the level of anxiety compared with the neutral environment. The high level of anxiety shown after visiting this virtual environment reflects the importance that patients with eating disorders attribute to their body image and to the evaluation that others may make of it. In this environment subjects wear bathing-suits and are exposed to attractive young people also wearing bathing-suits, so aspects such as body dissatisfaction and negative social comparison contribute to raise their level of anxiety. Thompson and Chad (2002) affirm that subjects with negative perception and thoughts regarding their body shape are usually worried about how others see them; this is clearly the case of patients with ED. The authors add that these subjects may try to avoid situations in which their body is exposed to others, as is the case of the swimming-pool.

One of the aims of the design of the virtual environments was to make the effects of food and people additive, so we expected the restaurant high-calorie environment to provoke the highest levels of reactivity in subjects because of the presence of people and the presence of high-calorie food at the same time. However, though there was no interaction between the variables, the presence or absence of people had no significant effect in the restaurant situation. Food was the only effect that was significant in all situations, for both anxiety and depression. This

means that the subject's exposure to a situation with low or high calorie food does indeed produce substantial changes in their level of anxiety and their mood, a finding that appears to confirm our first hypothesis. Nevertheless, the second hypothesis is not verified.

The results of this study confirm the utility of virtual environments as instruments capable of provoking emotional reactions in patients with eating disorders, but they show too that it is necessary to introduce changes to improve the effectiveness of some of the developed situations. Particularly, the interaction with the application should be increased, especially with regard to the avatars representing human figures. In contrast to the food stimuli, which the subject can eat, in none of the environments was there any interaction between the subject and the other people present. This is probably why the presence or absence of other people has not produced significant changes in the levels of emotional reactivity.

CONCLUSION

Virtual reality seems to be a valid instrument particularly useful for simulating everyday situations that may provoke emotional reactions such as anxiety and depression, in patients with ED. Virtual environments in which subjects are obliged to ingest high-calorie food provoke the highest levels of state anxiety and depression. Nonetheless, certain changes need to be introduced in the environments in order to increase the impact that the presence of people has on the patients. These changes should aim principally to add movement and sound to the avatars representing human figures and increase the degree of interactivity between the users and the virtual environments.

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Contact

Marta Ferrer-Garcia
Departamento de Personalidad
Evaluación y Tratamientos Psicológicos
Facultad de Psicología.
Paseo Valle de Hebron, 171
08035 Barcelona, Spain
Tel: +34933125126
Fax: +34934021362
E-mail: jgutierrezm@ub.edu
E-mail : martaferrerg@ub.edu