

Virtual Reality Exposure in Patients with Eating Disorders: Influence of Symptom Severity and Presence

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Abstract. The aim of this study was to examine the influence of several modulating variables on subjective discomfort experienced by patients with eating disorders while exposed to virtual environments that were emotionally significant for them. Severity of symptoms and sense of presence were analyzed. Both variables influenced the level of subjective discomfort during the exposure to virtual environments.

Keywords. Virtual Reality, eating disorders, subjective discomfort

Introduction

Virtual Reality (VR) is a useful technology for body image disturbance assessment and treatment [1, 2]. Nevertheless, the successful use of VR in therapeutic interventions requires eliciting the same degree of anxiety as produced in the real-life situation [3, 4]. Previous studies assessed the capability of VR environments to provoke responses of anxiety and depression in participants with eating disorders (ED) [5, 6]. These studies showed that ED patients felt more anxiety, assessed with the STAI-S [7], and a more depressed mood, assessed with the CDB [8], in VR environments where they had to eat high-calorie food (both alone in the kitchen and in a restaurant with other people) and in VR environments simulating social situations, specifically, talking with friends in a swimming-pool. In contrast, controls showed similar responses in all situations [5, 6]. Given the capability of VR environments to produce emotional responses in ED patients, the aim of this study was to explore whether possible modulating variables, such as symptom severity and sense of presence, may influence the level of subjective discomfort experienced by ED patients in the VR environments. In this study presence was understood as the “sense of being” in the virtual environment (VE), that is to say, the feeling that the VE was the dominant reality and was experienced by the users as a place they visited [9].

1. Method

1.1. Participants

Seventy-one patients diagnosed with eating disorders (49 women with anorexia nervosa and 22 women with bulimia nervosa) participated in the study. All of them were in treatment at different hospitals and private clinics in Barcelona, Spain. Participants were volunteers and gave informed consent. The mean age of patients was 19.65 ($SD = 4.98$) and their mean Body Mass Index (BMI) was 19.70 ($SD = 3.17$). There were no significant age differences between AN ($M = 19.27$, $SD = 5.39$) and BN ($M = 20.50$, $SD = 3.88$) patients. However, the BMI of patients with AN ($M = 18.22$, $SD = 1.75$) was significantly lower ($t = -6.58$, $p < .001$) than the BMI of BN patients ($M = 23$, $SD = 3.19$). The study was approved by the ethics committee.

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1.2. Assessment

- Subjective discomfort: Measured with a visual analogical scale (0-100)
- Sense of presence: Measured with a Spanish translation of the Presence Questionnaire (PQ) [9]
- ED symptoms: Measured with the Eating Attitudes Test-26 (EAT-26) [10]

1.3. Procedure

Tests were administered in two stages. In the first stage, participants were requested to fill in the EAT-26 and were measured and weighed in order to obtain their BMI. In the second stage, participants were exposed to the VEs. Since patients with ED are known to experience anxiety while eating and in social situations, we considered the variable food (no food, low-calorie food, and high-calorie food) and the variable people (no other people present and other people present) when developing the VEs. The combination of the two variables gave rise to a repeated measures design (2x3) with six conditions: The neutral room (with no food and no other people present), the kitchen with low-calorie food and no other people present, the kitchen with high-calorie food and no other people present, the restaurant with low-calorie food and other people present, the restaurant with high-calorie food and other people present, and the swimming-pool (with no food and other people present). Both in the restaurant and the kitchen, participants had to eat the virtual food by clicking on it with the mouse. Both in the restaurant and in the swimming-pool, participants were immersed in a social situation where they chatted with friends. First, participants visited the neutral VE and both subjective discomfort (SUD) and sense of presence were assessed. Then, the five experimental VEs were randomly administered. Experienced subjective discomfort and sense of presence were assessed again in the interval between the presentations of each experimental VEs.

2. Results

ED patients showed significantly higher levels of subjective discomfort in the kitchen with low-calorie food ($F [5, 71] = 25.79, p < .001, \eta^2 = 0.27$), the kitchen with high-calorie food ($F [5, 71] = 200.40, p < .001, \eta^2 = 0.74$), the restaurant with low-calorie food ($F [5, 71] = 54.12, p < .001, \eta^2 = 0.44$), the restaurant with high-calorie food ($F [5, 71] = 148.30, p < .001, \eta^2 = 0.68$), and the swimming-pool ($F [5, 71] = 101.07, p < .001, \eta^2 = 0.60$) compared to the neutral room. High-calorie environments and social situations produced the highest levels of subjective discomfort.

We also explored whether the presence of possible modulating variables influenced the results. Symptom severity and sense of presence were analyzed. BMI was introduced as a covariate in the analyses. The sample was divided into three equal groups according to the scores obtained on the EAT-26: mild ($n = 24$, scores from 0 to 16), moderate ($n = 23$, scores from 17 to 46), and severe ($n = 24$, scores from 47 to 71) symptomatology. A repeated measure analysis of variance 3 x 6 was conducted. The simple effect of symptom severity ($F [2, 71] = 27.17, p < .001, \eta^2 = 0.45$) was significant (Figure 1). Patients with severe symptomatology showed a higher subjective discomfort in all the environments compared to patients with moderate symptoms. Likewise, patients with moderate symptoms showed a higher subjective discomfort than patients with mild symptoms in all the environments. The interaction between the VE and the severity of symptoms was significant in the high-calorie kitchen, the low-calorie restaurant, the high-calorie restaurant, and the swimming-pool (Table 1). The group with severe symptoms showed the greatest disparity between discomfort experienced in these situations and the neutral room.

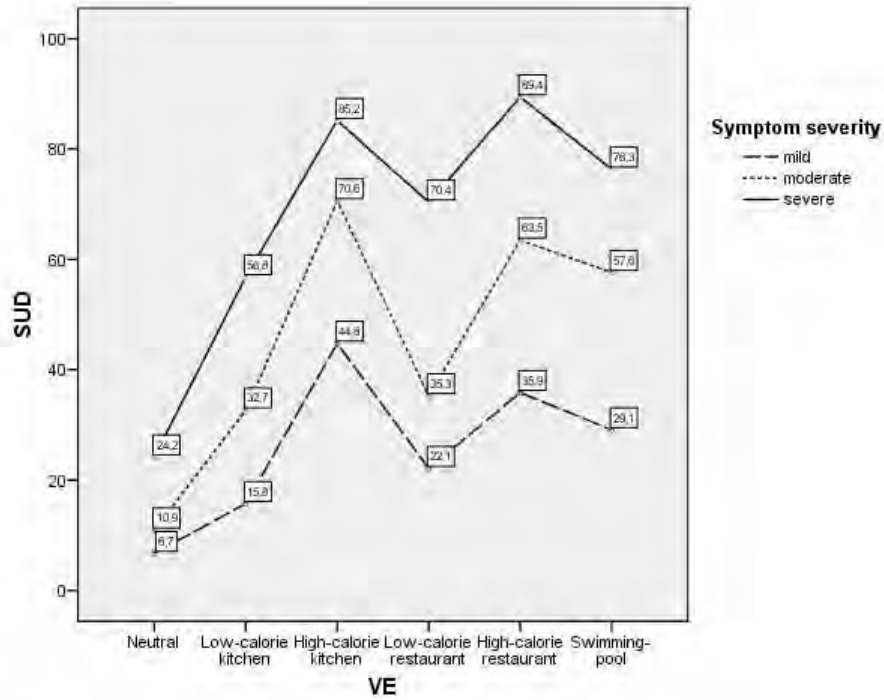


Figure 1. SUD means obtained by mild, moderate and severe ED patients in each VE.

Similar results were found when analyzing the sense of presence. We divided the sample into three equal groups: low sense of presence ($n = 23$, scores from 6 to 25.8), moderate sense of presence ($n = 24$, scores from 26 to 31.3), and high sense of presence ($n = 24$, scores from 31.5 to 38.7). The simple effect of the sense of presence was significant ($F [2, 71] = 3.79, p = .028, \eta^2 = 0.10$). ED patients with high sense of presence showed the highest levels of subjective discomfort in all situations but the neutral room (Figure 2). Patients with a moderate sense of presence showed higher levels of discomfort in the neutral environment than patients with a high sense of presence.

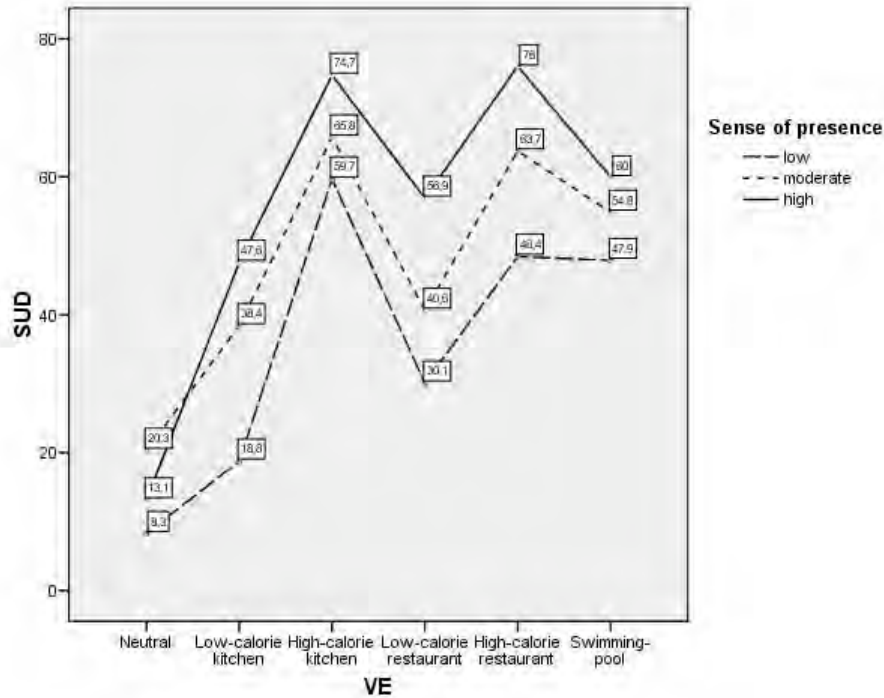


Figure 2. SUD means obtained by patients with low, moderate, and high sense of presence in each VE.

Furthermore, the interaction between presence and VE was significant in the kitchen with low-calorie food, the restaurant with low-calorie food, and the restaurant with high-calorie food (Table 1). The high presence group showed the greatest disparity between discomfort experienced in these situations and the neutral room.

Table 1. Interactions in repeated measures analysis 3 (mild vs. middle vs. severe symptoms) x 6 (VEs) and the repeated measures analysis 3 (low vs. moderate vs. high presence) x 6 (VEs)

VE	Severity			Presence		
	<i>F</i>	<i>p</i>	η^2	<i>F</i>	<i>p</i>	η^2
Low calorie kitchen – Neutral room	2.66	.07	.07	3.01	.056	.08
High calorie kitchen – Neutral room	4.19	.019	.11	1.63	.20	.05
Low calorie restaurant – Neutral room	5.88	.004	.15	4.09	.021	.11
High calorie restaurant – Neutral room	7.92	.001	.19	3.31	.042	.09
Swimming pool – Neutral room	5.65	.005	.14	0.78	.459	.02

3. Conclusions

As previously reported in different studies [5, 6], exposure to VEs produced changes in ED patients' mood. High-calorie environments and the swimming-pool elicited the highest levels of subjective discomfort. Moreover, emotional reactions to VEs differed according to the severity of the ED symptomatology and the sense of presence experienced during the exposure to VR. Patients with severe symptoms reacted more strongly than patients with mild and moderate symptoms. This difference was stronger in situations where participants had to eat the virtual high-calorie food (both in the kitchen and the restaurant) and in the swimming-pool. Refusing to eat high-calorie food and avoiding some social situations, such as eating when other people are present and exposing the own body to the scrutiny of others, are characteristic symptoms of eating disorders. Consequently, ED patients with severe symptoms are especially sensitive to these situations.

Also, higher levels of presence were related to higher subjective discomfort. Presence refers to the sensation of “being there” [11] experienced by users when being exposed to a VE. A higher sense of presence usually reflects a more realistic and intense experience of the simulated situation, and consequently, should be related with a stronger emotional reaction of participants. As expected, patients who reported a higher sensation of “being there” showed higher discomfort in the experimental VEs. In a previous study [5] we exposed 30 ED patients to six similar virtual situations. The sense of presence reported by participants was very low and had no significant effect on their mood. Then, we hypothesized that a higher sense of presence could be achieved by increasing the levels of immersion and interaction in the VEs. In the present study we used more interactive environments, where avatars speak to the participants and perform several actions. We assume that improving the environments and increasing the sample have both contributed to enhancing the effect of the variable presence in this study.

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