

Targeting the fear of gaining weight and body-related concerns in Anorexia Nervosa. Preliminary findings from a Virtual Reality randomized clinical trial.

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Abstract. Based on the preliminary findings of a randomized clinical trial with patients with Anorexia Nervosa (AN), this study aims to provide initial evidence of the usefulness of a Virtual Reality body exposure therapy. Method: 17 AN patients (9 in the experimental group, 8 in the control group) participated in the study. Fear of gaining weight (FGW), body anxiety, drive for thinness, body image disturbances (BID), Body Mass Index (BMI) and body-related attention were assessed before and after the intervention. Additionally, the experimental group underwent five sessions of VR body exposure therapy within the standard course of CBT, while control patients received the usual CBT. Results: After the intervention, there were clear reductions in ED symptoms in both groups. The reduction was especially marked in the experimental group. Finally, notable changes were recorded in dysfunctional body-related attention and BMI in the experimental group, but not in controls. Conclusion: To the best of our knowledge, this is the first study to focus on treating FGW, body-related concerns and body-related attention in AN using a VR-embodiment based paradigm. To pursue the analysis further, and to assess the effectiveness of this new VR software, larger controlled clinical trials should now be conducted.

Keywords. Virtual reality, anorexia nervosa, fear of gaining weight, body exposure therapy, body-related attentional bias

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1. Introduction

Previous studies have highlighted the need to address both fear of gaining weight [FGW; 1-2] and body image disturbance [BID; 3] in the treatment of anorexia nervosa (AN). Exposure-based interventions have been proposed as an appropriate method for the treatment of these disturbances [4]. However, exposure-based therapies such as imagery exposure have important limitations, such as the difficulty of achieving or maintaining visualization. The use of virtual reality (VR)-based exposure techniques may overcome these limitations and enable the use of novel methods such as embodiment techniques [5] for targeting body-related concerns and FGW.

The current study describes a technique involving VR body exposure to ED symptoms in AN patients to help them to recover healthy weight. It provides initial evidence of the usefulness of this VR-software based on the preliminary findings of a randomized clinical trial. Specifically, the experimental group was exposed to five additional sessions of VR body exposure therapy as part of standard cognitive behavioral therapy (CBT), while patients in the control group received the usual CBT. Reductions in FGW, body anxiety, BID, and body-related attentional bias, as well as increased BMI levels, were hypothesized in both groups, and were expected to be more significant in the experimental group.

2. Method

2.1. Participants

Eighteen adolescent patients (9 in the experimental group, 8 in the control group) participated in the study, with a primary diagnosis of anorexia nervosa (DSM-5) between 14 and 18 years old. Participants were recruited at the Eating Disorders Unit of the Hospital Sant Joan de Déu in Barcelona.

2.2. Instruments

Patients were exposed to immersive virtual scenario using a VR head mounted display (HTC-VIVE). In addition to the two controllers that HTC-VIVE usually provides, three additional body trackers were used to achieve full body motion tracking. Furthermore, VR HMD FOVE Eye Tracking was used to assess the body-related attentional bias. Virtual avatars were created by Unity 3D and Blender 2.78. The virtual environment was a simple room without any furnishings, with a large mirror placed 1.5 meters in front of the patient. A young female avatar wearing a basic white t-shirt with blue jeans and black trainers was created. Before starting the treatment (pre-evaluation) and at the end of the treatment (post-evaluation), the following measures were assessed:

- Evaluation of change in body weight: BMI.
- Eating Disorders Inventory-3 (EDI-3; Garner, 2004) drive for thinness (EDI-DT) and body dissatisfaction (EDI-BD) scales.
- Physical Appearance State Anxiety Scale (PASTAS; Reed, Thompson, Brannick and Sacco, 1991).
- Body Appreciation Scale (BAS; Avalos, Tylka and Wood-Barcalow, 2005).
- Figural Drawing Scale for Body Image Assessment (BIAS-BD; Gardner, Jappe, & Gardner, 2009), Body dissatisfaction (BIAS-O) and Body distortion (BIAS-X)

Evaluation of attentional bias towards the body:

- Complete time of fixation (evaluated in milliseconds) of the gaze towards weight-related and non-weight-related body parts.

- Number of fixations of the gaze towards weight-related and non-weight-related body parts.

2.3. Procedure

Prior to treatment, written informed consent were obtained from both patients and their parents. The VR exposure intervention consisted of five sessions that were administered by two general health psychologist with clinical experience in the treatment of adolescents. In the **pre-assessment session**, which lasted approximately one hour, the virtual avatar was generated by taking a frontal and lateral photo of the patient and creating an avatar whose silhouette matched the pictures by adjusting the different parts of its silhouette to the photographs. In the meantime, the other therapist administered the pre-assessment questionnaires and answered the patient's questions.

Next, the FBI was induced using two different procedures, a visuo-motor and visuo-tactile stimulation, both procedures lasted three minutes. Once the FBI was induced, the three VAS examining intensity of the FBI, body-related anxiety and the FGW were assessed.

According to the **treatment sessions**, each of the five-exposure session, lasted approximately 1 hour and took place once a week. The body exposure treatment was initiated with a virtual body with the same BMI as the patient. During the following sessions, the BMI of the avatar was progressively increased until the target weight (healthy BMI) was reached. During exposure to each avatar, the participant was asked to focus on different parts of the virtual body, by asking what they think and feel about them. In addition, the patient was asked about the level of anxiety experienced every 120 seconds throughout the exposure session (VAS-A). Once the anxiety levels had decreased by 40% with respect to the initial measure, the session was terminated.

Each of the following treatment sessions began with the next BMI increase. In cases where the initial whole-body anxiety had not fallen by 40% or if the exposure to various parts of the body had not been completed, exposure to the same avatar as the previous session was repeated.

2.4. Statistical analyses

The analysis software Ogama (Open Gaze Mouse Analyzer) was used to transform the eye-tracking raw data into suitable quantitative data. An additional data transformation was conducted by subtracting the difference between weight-related and non-weight-related AOIs. Therefore, a positive outcome would mean that the participant had been looking more at the W-related body parts than at the NW-related body parts, while a negative outcome would mean the opposite. Mixed between (group)–within (pre-post assessment times) analyses of variance (ANOVA) were conducted for all measures. The outcome of the intervention, including the AOIs data, was analyzed by the statistical software IBM SPSS Statistics v.23.

3. Results

Mixed between (Groups)-within (Time) analyses of variance showed statistically significant interactions between group and time in complete fixation time ($F(1,13) = 8.991, p = .010, \eta^2 = .409$), number of fixations ($F(1,13) = 5.459, p = .036, \eta^2 = .296$) and BMI ($F(1,16) = 5.418, p = .033, \eta^2 = .253$).

Post-hoc analyses revealed significant group differences ($p < .05$) in post-assessment in BMI and complete fixation time. The experimental group reported significantly lower body-related attentional bias toward weight-related body parts (see figures 1 and 2), and higher BMI levels compared to the control group. There were also significant main effects of time ($p < .05$) in FGW, drive for thinness, body dissatisfaction, body distortion and body anxiety.

Overall, in the post-assessment, both groups showed clear reductions in ED symptoms (see table 1). This reduction was more evident in the experimental group.

Table 1. Mean and Standard Deviation of the pre- and post-treatment results as assessed by the following measures.

Measures	Pre-treatment session		Post-treatment session	
	Experimental	Control	Experimental	Control
EDI-DT	21.13 (5.35)	21.11 (3.94)	16.67 (5.61)	17.25 (6.97)
EDI-BD	25.78 (3.85)	28.38 (4.66)	21.22 (6.30)	25.63 (7.42)
PASTAS	18.56 (6.52)	21.25 (3.28)	13.67 (5.61)	19.66 (6.19)
BIAS-Body distortion	48.33 (20.92)	41.88 (11.32)	30.56 (18.91)	36.88 (10.33)
BIAS- Body dissatisfaction	45.56 (21.85)	37.50 (16.90)	27.38 (19.54)	34.78 (11.78)
BAS	27.56 (7.94)	27.63 (5.06)	31.67 (9.42)	30.25 (9.72)
VAS-FBI	42.00 (31.63)	45.63 (32.89)	66.11 (26.78)	47.50 (21.21)
VAS-A	43.33 (33.17)	42.50 (30.12)	37.22 (25.87)	45.63 (31.10)
VAS-FGW	81.11 (22.04)	82.50 (27.12)	58.33 (21.79)	78.75 (24.75)

Note: Body Mass Index (BMI), Eating Disorder Inventory (EDI-3) drive for thinness (DT) and body dissatisfaction (BD) scales, Physical Appearance State and Trait Anxiety Scale (PASTAS), Body Image Assessment Test (BIAS), Body Appreciation Scale (BAS), Visual analog scales (VAS) of full-body illusion (FBI), body anxiety (A) and Fear of Gaining Weight (FGW).

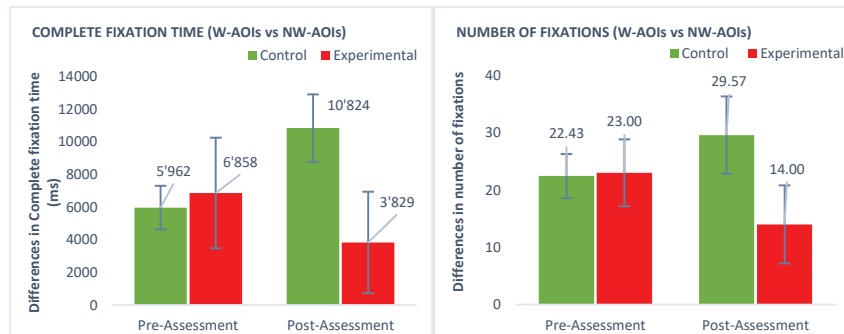


Figure 1 and 2. Group differences (experimental vs control group) in mean complete fixation time, in milliseconds (*ms*), and number of fixations at weight vs non-weight-related Areas of Interest (AOIs), for each assessment time condition. Error bars represent standard error (SE), based on 2SE. Note: VB= Virtual body.

4. Conclusion

This study describes an innovative VR-based exposure procedure which obtained promising results for enhancing CBT in ED.

Specifically, our results showed that patients at the experimental group reached a faster weight restoration and showed a significantly reduction of body-related AB compared to patients at the control group, at the post-assessment and follow-up. While promising non-significant tendencies were also found at other body-related measures, such as FGW, body distortion, body anxiety, body dissatisfaction, drive for thinness, and body appreciation. These results are important since a weight restoration is considered as one of the most robust predictors of remission from AN and it is necessary for recovery [6].

Regarding body-related AB, a key aspect to understand these results might rely on the procedure conducted at the experimental group, in which, patients had to focus on different parts of the virtual body (from the head to the shoes) and were asked to orally express what they think and feel about those body areas. Thus, since patients had to look at those parts

during certain amount of time, and every session, it could be expected that they would have also reduced their AB toward weight-related body areas, spreading their attention more equally among all parts of the body. Indeed, similar procedures have been conducted in previous studies with women with high BD, in which a temporary AB toward (un)attractive body areas were induced to reduce BD levels among healthy women [7-8]. To pursue the analysis further, and to assess the effectiveness of this new VR software, a randomized clinical trial with a larger sample should now be conducted.

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