# Going beyond body exposure therapy. Presenting an innovative Virtual Reality and Eye-Tracking body-related attentional bias task.

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**Abstract.** The present study provides preliminary findings of an innovative body-related attentional bias modification task (ABMT) using Virtual Reality (VR) and Eye-tracking (ET) technologies. Analyses were carried out on a sample composed of college women (n = 35) who were divided into groups of those with high body dissatisfaction (n = 16) and those with low body dissatisfaction (n = 19). All participants were exposed to an immersive virtual environment in which they were embodied in a virtual body that resembled the measurements of their real body. Subjects performed the body-related attentional bias modification task for 20-minutes. Eating Disorder (ED) symptomatology disturbances and body-related attentional bias (AB) were measured before and after a single session of the VR-ABMT. Results showed a significant ($p<.05$) reduction of fear of gaining weight after the intervention among women with high body dissatisfaction. Our results indicated promising evidence in favor of using this ABMT, particularly among women with high body dissatisfaction. In addition, the current research provides a new application of VR and ET technologies that might open a wide range of possibilities for designing and developing new body-related interventions among patients with EDs and women with body image disturbances.

**Keywords.** Attentional Bias Modification Training, Virtual Reality, Eye-Tracking, Body Image Disturbances, Fear of Gaining Weight.

## 1. Introduction

In a phenomenon known as attentional bias (AB), described as the propensity to pay more attention to certain types of stimuli or information (e.g., disorder-relevant information) over other sorts of information [1], adult and young patients with eating disorders (EDs) and women with high body dissatisfaction show a tendency to focus more on self-reported unattractive body parts than other body parts [2-3]. Dysfunctional body-related AB may be responsible for decreasing the effectiveness of body exposure-based treatments used in patients with EDs. For example, some patients may tend to avoid or on the contrary, overlook at those self-reported unattractive body areas, interfering with the exposure-based task.

For this reason, it is necessary to develop new treatment techniques by adding specific components that aim to reduce the body-related AB. One way to target body-related fears is through exposure therapy. Previous studies have shown promising results in this field through the use of mirror exposure therapy [4] or Virtual Reality [5].These techniques usually

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involve the patients systematically observing their body or specific body parts for a certain amount of time [4]. The current project aims to go further and includes AB modification techniques within the body exposure therapy as a method to reduce body-related AB, body dissatisfaction, fear of gaining weight, and body anxiety among patients with EDs (for further details, see clinicaltrials.gov, NCT04786951). The main aim of this study is to develop an innovative body-related attentional bias modification task using VR and ET technologies. Particularly, this study provides preliminary findings of a single session of ABMT among healthy women with high and low body dissatisfaction (BD) levels.

## 2. Method

### *2.1. Sample*

Thirty-five women at the University of Barcelona participated in the study and were recruited through campus flyers and advertisements in social network groups. The exclusion criteria were a self-reported diagnosis of a current ED, a Body Mass Index (BMI) of less than 17 or more than 30, or a self-reported current severe mental disorder diagnosis. Each participant was given an identification code to guarantee the confidentiality of the data. This study was approved by the ethics committee of the University of Barcelona.

### *2.2. Measures*

The following measures were utilized before and after the task (pre-post evaluation):

- Full body illusion (FBI), body anxiety, and fear of gaining weight (FGW) were assessed by means of visual analog scales (VAS) estimating the intensity of the illusion and the FGW and anxiety related to the whole body from 0 to 100.
- The *Physical Appearance State and Trait Anxiety Scale* [PASTAS; 6] was used as a self-reported questionnaire that assesses body anxiety. The PASTAS is comprised of two self-report scales measuring weight-related and non-weight-related anxiety, but only the weight scale (W) with 8 items was used in the current study.
- The 10-item body dissatisfaction scale of the *Eating Disorder Inventory* (EDI-3 BD; Garner, 2004) was used to assess body dissatisfaction with the whole body and specific body parts. Particularly, the Spanish version of the EDI-3 was used in this study.

**AB measures**: In accordance with the Weight Scale items of the PASTAS, the same areas of interest (AOIs) were individually drawn onto a 2D frontal view picture of a female avatar and were labeled as weight-related body parts (W-AOIs), i.e., thighs, buttocks, hips, stomach, legs and waist.

The participant's visual fixation was estimated by the following variables:

- Number of fixations on W-AOIs (NF): number of available fixations on the specified area of interest group (i.e., weight-related AOIs).
- Complete fixation time on W-AOIs (CFT): sum of the fixation duration at the specified area of interest group (i.e., weight-related AOIs) in milliseconds.

### *2.3. Instruments*

**Hardware:** Participants were exposed to an immersive virtual environment using a VR head-mounted display (HMD) (HTCVIVE Pro Eye) with a precise ET device included (Tobii ET). In addition to the two controllers this HMD usually provides, three additional body trackers were used to achieve full body motion tracking.

**Software:** The female avatar was designed using the software Blender v. 2.78. A young female avatar wearing a basic white t-shirt with blue jeans and black trainers was created. The avatar also wore a swim cap to avoid any influence of hairstyle. The Unity 3D 5.6.1 (Unity Technologies) software was used to design the VR room, develop the programming

code, and incorporate the virtual avatars within. The virtual environment consisted of a unique room without any furniture except for a large mirror on the wall placed 1.5 m in front of the patient. Participants could see their whole body reflected in the mirror, even when they were moving.

### *2.4. Procedure*

The virtual avatar was generated by taking a frontal and lateral photo of the participant. To match the silhouette of the avatar to the actual silhouette of the participant, different parts of the pictures were adjusted. Simultaneously, the other researchers administered the pre-assessment questionnaires and answered the participant's questions. Next, the full body illusion (FBI) was induced over the virtual body (i.e., to perceive and regard a virtual body as their own real body) using two procedures: visuo-motor and visuo-tactile stimulation. Both procedures lasted three minutes. Once the FBI was induced, the participant's gaze was tracked while they were asked to observe their virtual body in the mirror for 30 seconds to assess body-related AB. During this process, and as a cover story, participants were told to stand still and avoid abrupt head movements while the virtual avatar position was being recalibrated.

The ABMT was based on an adaptation of the AB induction procedure proposed by Smeets et al. [7]. The training was developed by selecting a series of geometric figures (e.g., square, rectangle, and circle) that roughly matched specific parts of the participant's body. Each of these figures had different colors and sizes. Participants were instructed to detect and identify the figures that appeared on different parts of the avatar's body. Specifically, participants were asked to focus their attention on that body part for 4 seconds while it was progressively illuminated. Afterwards, the figure appeared on another part of the body. In 45% of the trials, the geometric figures appeared on weight-related body parts, and in another 45% of the trials, the figures appeared on non-weight-related body parts. In the remaining trials (10%), the figures appeared on three neutral objects located next to the avatar.

### 2.5. Statistical analyses

The analysis software Ogama (Open Gaze Mouse Analyzer) was used to transform the eye-tracking raw information into suitable quantitative data. An additional data transformation was conducted by calculating the difference for each attentional variable between weight-related and non-weight-related AOIs. For further details, see Porras-Garcia et al. [5]. The outcome of the intervention was analyzed by the statistical software IBM SPSS Statistics v.25. The participants were divided into high vs. low BD levels using the median score of the EDI-BD as a cut-off point (Me BD = 8). Finally, to investigate whether there was an attentional bias modification a mixed between (BD_levels)-within (Assessment_Time) analyses of variance (ANOVA) was conducted. All the assumptions were partially met; there was homogeneity of variances and sphericity, but some data were not normally distributed in some variables.

## 3. Results

The analyses did not show statistically significant group*time interactions in any of the measures assessed. However, the analysis further revealed main effects of time in fear of gaining weight ($F(1,31) = 4.553$, $p = .041$, partial $\eta 2 = .128$). As can be revised in Figure 1.h., all women, regardless of their body dissatisfaction levels, showed a tendency to reduce the fear of gaining weight levels after the intervention. When women with high and low body dissatisfaction were considered separately, the reduction in fear of gaining weight between the pre-post assessment was only significant among women with high BD ($F(1,23) = 5756$, $p = .022$, partial $\eta 2 = .158$).

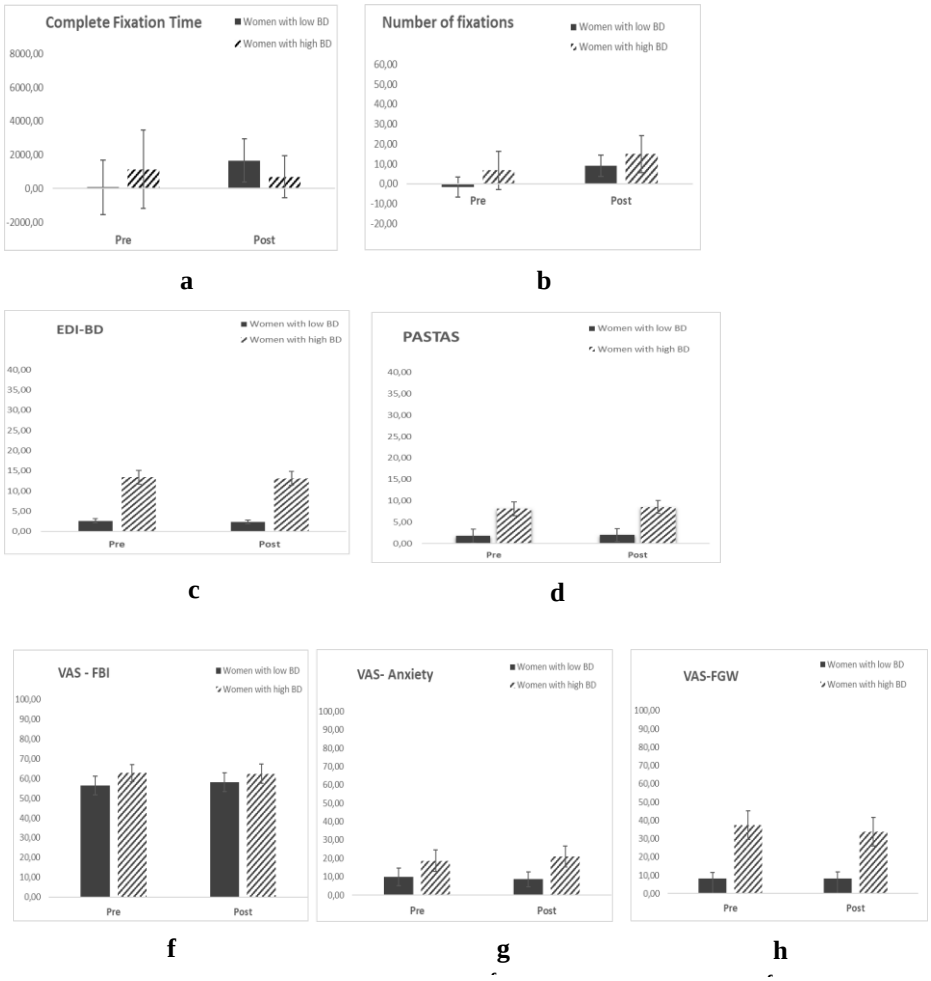


**Figure 1**. Means of the ED and AB measures between women with high and low body dissatisfaction, before and after the ABMT. Error bars represent standard errors.

## 4. Conclusions

Our results, although still preliminary, suggest that this procedure can be useful to reduce the FGW reported by healthy women, particularly those with higher body dissatisfaction. These results are noteworthy, since FGW is usually considered one of the more difficult fears to reduce in ED treatments due to the impossibility of directly confronting it through in vivo exposure therapies as with other sorts of fears [8]. However, these findings should be carefully considered since other ED or AB measures were not significantly reduced after the ABMT (e.g., body dissatisfaction). These results are partially in line with those reported by Smeets et al. [7] in which exposure to all body areas in a group of healthy women did not lead to a reduction of ED symptomatology. On the other hand, those women who only attended to their self-reported, most attractive body parts showed higher body satisfaction levels after the task [7]. Therefore, more studies are required to assess whether the sort of ABMT procedure toward the body or the number of sessions (e.g., a long-term intervention) might further improve the effectiveness of this intervention, particularly on those individuals with high body image disturbances or patients with EDs.

Future assessment and treatment of body image and EDs might benefit from the rapid technological advancement in VR and ET technologies and the countless possibilities that both technologies might provide to this field. The current study presented a pioneering

ABMT procedure taking advantage of both VR and ET technologies. The combination of both technologies might open a wide range of possibilities for designing and developing new body-related interventions that gradually retrain automatic body-related attentional processes in patients with EDs.

**Acknowledgements:** This study was supported by the Spanish Ministry of Science and Innovation (Project PID2019-108657RB-I00, and by AGAUR, Generalitat de Catalunya, 2017SGR1693.

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