An innovative virtual reality and eye-tracking-based attentional bias modification training into mirror exposure therapy for anorexia nervosa: preliminary findings from a case study.

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Patients with anorexia nervosa show dysfunctional body-related attentional bias.

Association with higher levels of body dissatisfaction.

Interference with the effectiveness of body exposure-based treatments.

Physical Appearance State and Trait Anxiety Scale (PASTAS; Thompson, 1999)
Body exposure-based therapies: Mirror exposure therapy (MET)

MET is an effective treatment for anorexia nervosa to reduce the anxiety experienced by patients about their bodies and fear of gaining weight through a habituation process.

Patients are exposed to their real bodies over a prolonged period expressing their emotions and thoughts about their body.

Looking at or avoiding looking at the most anxiety-producing body parts could interfere with the extinction of the anxiety response.
ATTENTIONAL BIAS MODIFICATION TRAINING (ABMT) can reduce attentional biases

- Improve anorexia nervosa symptomatology, such as body dissatisfaction
- Increase the efficacy of body exposure therapies
Increasing the efficacy of MET by incorporating ABMT into MET in the treatment of a female adolescent with anorexia nervosa.

Will the mirror exposure treatment’s efficacy increase by previously reducing the attentional bias?
Eye-tracking + Virtual reality
Case description

Female
17 years old
Diagnosis: anorexia nervosa
Comorbidity: major depressive disorder
Pharmacological treatment: anxiolytics and antidepressants
Outpatient program treatment: individual and group cognitive-behavioral therapy, nutritional rehabilitation and individual and group parent counseling

Procedure

1. Pre-treatment assessment session

2. 5 experimental sessions of 60 min:
   - Attentional bias modification training
   - Mirror exposure therapy

3. Post-treatment assessment session
The virtual avatar was created by taking a patient’s frontal photo which was manually overlapped on the silhouette of the virtual body by adapting the avatar’s body parts to the patient's silhouette.
In each clinical session:

1. Immersion in the virtual environment
2. Full body ownership illusion
3. Attentional bias modification training
4. Mirror exposure therapy
5. Exposure to a relaxing environment
Virtual reality environment

Full Body Motion Tracking
In each clinical session:

1. Immersion in the virtual environment
2. Full body ownership illusion
3. Attentional bias modification training
4. Mirror exposure therapy
5. Exposure to a relaxing environment
**VISUO-MOTOR STIMULATION PROCEDURE**

synchronizing the movements of the participant with the movements of the avatar using motion capture sensors placed on the hands and feet → participant could see how the virtual body was doing the same movements as the real body.

**VISUO-TACTILE STIMULATION PROCEDURE**

synchronizing the participant’s visual and tactile stimulation using a tactile controller → participant could see how her virtual body was touched by a virtual controller on the same areas of the real body touched by a real controller.
In each clinical session:

1. Immersion in the virtual environment
2. Full body ownership illusion
3. Attentional bias modification training
4. Mirror exposure therapy
5. Exposure to a relaxing environment
The attentional bias modification training goal was to balance the attention between weight and non-weight-related body parts.

150 figures divided into two blocks of 75 figure

10-15 minutes task

The patient was asked to be staring for 4 seconds at the figures that appeared on a specific body part of the avatar, while it was progressively illuminated until the end of the 4 seconds, and then to move on to the next figure presentation.
In each clinical session:

1. Immersion in the virtual environment
2. Full body ownership illusion
3. Attentional bias modification training
4. Mirror exposure therapy
5. Exposure to a relaxing environment
The patient was asked to focus on different parts of the virtual body and to orally report her thoughts and feelings.

The level of experienced anxiety was evaluated every 120 seconds.
VR technology offers the possibility of performing ABMT and MET by allowing the patient to experience the illusion of ownership of a virtual body that progressively increases weight until reaching a healthy body mass index.

To progress in the hierarchy, anxiety must decrease by 40% in the previous session.
In each clinical session:

1. Immersion in the virtual environment
2. Full body ownership illusion
3. Attentional bias modification training
4. Mirror exposure therapy
5. Exposure to a relaxing environment
<table>
<thead>
<tr>
<th>Measure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pre-post treatment measures</strong></td>
<td></td>
</tr>
<tr>
<td>Full Body Ownership Illusion</td>
<td>Visual Analogue Scales (VAS) from 0 to 100</td>
</tr>
<tr>
<td>Fear of Gaining Weight</td>
<td></td>
</tr>
<tr>
<td><strong>Within-treatment sessions measures</strong></td>
<td></td>
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<tr>
<td>Body weight</td>
<td>Body Mass Index (BMI)</td>
</tr>
<tr>
<td>Body dissatisfaction</td>
<td>Spanish version of the <strong>Body Dissatisfaction subscale</strong> of the EDI-BD</td>
</tr>
<tr>
<td>Drive for thinness</td>
<td>Spanish version of the <strong>Drive for Thinness subscale</strong> of the EDI-DT</td>
</tr>
<tr>
<td>Body-checking behaviors</td>
<td><strong>Body Checking Questionnaire</strong> (BCQ)</td>
</tr>
<tr>
<td>Body appreciation</td>
<td><strong>Body Appreciation Scale</strong> (BAS)</td>
</tr>
</tbody>
</table>
During each session, anxiety decreased by 40% allowing the patient to progress through the virtual BMI hierarchy until she reached the minimum healthy weight of the avatar in the last session.
**RESULTS:** body mass index values of the patient

BMI increased slightly post-treatment without reaching the minimum healthy weight.
## RESULTS

The reliable changes index (RCI) for single cases was calculated for the post-assessment measurements only for the measures with clinical and community means and standard deviations.

<table>
<thead>
<tr>
<th>Measure</th>
<th>Pre-treatment score</th>
<th>Post-treatment score</th>
<th>Reliable Change Index</th>
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<tbody>
<tr>
<td>Body dissatisfaction</td>
<td>27</td>
<td>16</td>
<td>2.18*</td>
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<tr>
<td>EDI-BD</td>
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<tr>
<td>Drive for thinness</td>
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<td>5</td>
<td>2.32*</td>
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<tr>
<td>EDI-DT</td>
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<tr>
<td>Body appreciation</td>
<td>24</td>
<td>46</td>
<td>-5*</td>
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<tr>
<td>BAS</td>
<td></td>
<td></td>
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<tr>
<td>Body checking behaviours</td>
<td>49</td>
<td>36</td>
<td>1.42</td>
</tr>
<tr>
<td>BCQ</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*An RCI > 1.96 denotes a statistically significant difference.*
RESULTS

**BODY DISSATISFACTION***

- Pre-treatment: 27
- Post-treatment: 16

**DRIVE FOR THINNESS***

- Pre-treatment: 14
- Post-treatment: 5

**BODY APPRECIATION***

- Pre-treatment: 24
- Post-treatment: 46

**BODY CHECKING BEHAVIOURS**

- Pre-treatment: 49
- Post-treatment: 36

*statistically significant difference
A medium-high level of full body ownership illusion was maintained across all sessions.

Fear of gaining weight levels decreased from the 4th treatment session onwards.
Innovations

Incorporate a pioneering ABMT into MET

Take advantage of virtual reality and eye-tracking technologies
To advance this preliminary study and evaluate the effectiveness of incorporating ABMT into MET, a controlled clinical trial is necessary.

Our group is now conducting a randomized controlled clinical trial*

Control group I
Cognitive behavioral therapy

Control group II
Cognitive behavioral therapy + Virtual-reality-based Mirror Exposure Therapy

Experimental group
Cognitive behavioral therapy + Virtual-reality & Eye-tracking-based attentional bias modification training + Virtual-reality-based Mirror Exposure Therapy

*Clinicaltrials.gov, NCT 04786951
This augmentation of MET through ABMT based on virtual reality and eye-tracking could open up a wide range of possibilities for new interventions to improve the symptomatology of patients with anorexia nervosa.
Thank you!

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