Treatment of anorexia nervosa through virtual reality exposure

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A collaboration between

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ANOREXIA NERVOSA (AN)

- 1–4% of women and 0.3–0.7% of men (Europe)
- higher mortality rates than other eating disorders
- increasingly diagnosed in early adolescence

Diagnostic Criteria for Anorexia Nervosa (DSM-5)

- Restriction of energy intake relative to requirements, leading to significantly low body weight for the patient’s age, sex, developmental trajectory, and physical health. Significantly low weight is defined as a weight that is less than the minimal normal weight or, in children and adolescents, less than the minimal expected weight.
- Disturbance in the way in which one’s body weight or shape is experienced, undue influence of body weight or shape on self-evaluation, or persistent lack of recognition of the seriousness of the current low body weight.
- Intense fear of gaining weight or of becoming fat, or persistent behavior that interferes with weight gain, even though the patient has a significantly low weight.

+ multitude of medical complications
Body image disturbances (BID)

A series of dysfunctional **cognitions and emotions** related to the way in which individuals **experience, perceive and feel** their own **body shape or weight**.
Fear of gaining weight

Extreme fear of the possibility of gaining weight in the whole body or some specific body parts, even at significantly low weight.

Extinction of the FGW

via a progressive habituation process towards weight recovery

via mechanisms of the inhibitory learning systems

patients can learn new healthy associations with their weight and silhouette when their threatening weight-related expectations are not met
ANOREXIA NERVOSA TREATMENT

Recovery of a healthy weight

Fear of gaining weight

Interventions targeting body-related emotions and cognitions

Exposure-based therapy

Evidence-based therapies:

Cognitive behavioral therapy (CBT)

Family therapy
ANOREXIA NERVOSA TREATMENT: exposure-based therapy

Body exposure-based therapies

Mirror exposure therapy

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

Limitations

- Patients’ frequently negative initial reactions
- High risk of dropout
- Contraindicated in severe cases of AN
- Fear of gaining weight is impractical to confront in vivo
FEAR OF GAINING WEIGHT: *how it could be treated?*

Exposure therapy:
- with silhouette-distorting mirrors
- with photographs
- with imaginal exposure

**LIMITATIONS**

**IMAGINATIVE DIFFICULTIES**

**KEEPING EXPOSURE SUFFICIENTLY VIVID OVER TIME**

**AVOIDANCE STRATEGIES**

**LACK OF REALISM**
VIRTUAL REALITY (VR)-BASED EXPOSURE TECHNIQUES MAY OVERCOME THESE LIMITATIONS

A computer-generated environment that simulates **physical presence** and allows the person to **interact in real-time** with three-dimensional scenarios capable of **recreating reality or imaginary worlds**.
VR simulates real life
VIRTUAL REALITY EMBODIMENT-BASED TECHNIQUES

VR embodiment-based procedures can modify and improve the perception of the whole body or specific body parts.

FULL BODY OWNERSHIP ILLUSION

subjective experience in which individuals perceive an artificial body as their own body by combining different types of information into different multisensory representations.

VISUO-MOTOR STIMULATION

VISUO-TACTILE STIMULATION
Synchronizing the movement of the participant and the avatar using motion capture sensors placed on hands and feet.
Synchronizing participant’s visual and tactile stimulations: while the different areas of the body were touched on the participant, each participant observed the same areas being touched on the avatar at the same time by a tactile controller.
APPLICATIONS OF VR TO TREAT BODY IMAGE DISTURBANCES

MAIN ADVANTAGES

• Develop exact 3D figures of the individual's body with its particularities.
• Modify different parts of the body or the whole body depending on the therapeutic objectives.
• Represent abstract aspects such as perceived body size, ideal body size, weight gain.
• See the virtual body, "feel inside it" and be able to interact with it in the first person (1PP) or in the third person (looking in front of a mirror).
• Simulate real-life situations and expose the patient to anxiogenic situations in a safe environment.
• Visualization ability of the patient is not necessary.
• Control the patients’ gaze patterns towards their own bodies, using eye-tracking (ET) devices
Project: Development of virtual reality exposure techniques for the improvement of the treatment of AN

AN-VR-BE. A Randomized Controlled Trial for Reducing Fear of Gaining Weight and Other Eating Disorder Symptoms in Anorexia Nervosa through Virtual Reality-Based Body Exposure

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AN-VR-BE: MAIN OBJECTIVE

provide evidence of the efficacy of adding an embodiment-enhanced VR-based body exposure therapy to standard treatment for improving fear of gaining weight and body image disturbances in AN

**CONTROL GROUP**
Treatment as usual (TAU) → CBT

**EXPERIMENTAL GROUP**
5 sessions of VR-mirror exposure therapy + TAU

It was expected that the experimental group would show a significant increase in BMI values, and reductions in FGW levels and BIDs when compared to the control group after the treatment and three months later.
## PARTICIPANTS

<table>
<thead>
<tr>
<th></th>
<th>Experimental Group</th>
<th>Control Group</th>
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<tbody>
<tr>
<td>N=16</td>
<td></td>
<td>N=19</td>
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<table>
<thead>
<tr>
<th></th>
<th>Age, mean (SD)</th>
<th>Group Age, n (%)</th>
<th>Sex, n (%)</th>
<th>BMI, mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, mean (SD)</td>
<td>18.25 (1.30)</td>
<td>Adolescents</td>
<td>14 (87.5)</td>
<td>17.30 (1.06)</td>
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<tr>
<td>Group Age, n (%)</td>
<td></td>
<td>Adults</td>
<td>7 (43.75)</td>
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<tr>
<td></td>
<td></td>
<td>Women</td>
<td>2 (12.5)</td>
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<td></td>
<td></td>
<td>Men</td>
<td>2 (10.52)</td>
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<tr>
<td></td>
<td></td>
<td>Adolescents</td>
<td>12 (63.16)</td>
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<tr>
<td></td>
<td></td>
<td>Adults</td>
<td>7 (36.84)</td>
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<tr>
<td></td>
<td></td>
<td>Women</td>
<td>17 (89.47)</td>
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<td>Men</td>
<td>2 (10.52)</td>
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<td></td>
<td>Men</td>
<td>2 (10.52)</td>
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**Age, mean (SD)**: 18.25 (1.30) for Experimental Group, 19.21 (1.78) for Control Group; 17.30 (1.06) for Experimental Group, 17.54 (1.27) for Control Group.
**PRE-ASSESSMENT SESSION (1h)**

<table>
<thead>
<tr>
<th>Experimental group</th>
<th>Control group</th>
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</thead>
<tbody>
<tr>
<td>1. Informed consents</td>
<td>1. Photography procedure (To create the real-size VB)</td>
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<tr>
<td>2. Identification sheet</td>
<td>2. AN measures</td>
</tr>
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<td>3. Photography procedure (To create the real-size VB)</td>
<td>- BMI</td>
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<tr>
<td>4. AN measures</td>
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<tr>
<td>- BMI</td>
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<tr>
<td>- PASTAS (Body anxiety)</td>
<td></td>
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<tr>
<td>- EDI-3 (DT/BD SCALES)</td>
<td></td>
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<tr>
<td>- BIAS-BD (body distortion and body dissatisfaction)</td>
<td></td>
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<tr>
<td>- BAS (Body Appreciation)</td>
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<tr>
<td>5. Visomotor and viso-tactil FBI procedures. (HTC-VIVE PRO HMD)</td>
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<tr>
<td>6. VASs 0-100 (FGW, Body anxiety, FBI)</td>
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<tr>
<td>7. Eye-tracking assessment task. (FOVE-VR HMD)</td>
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**AN-VR-BE sessions (5 sessions of VR-MET of 45 min) + TAU**

<table>
<thead>
<tr>
<th>Session I</th>
<th>Session II</th>
<th>Session III</th>
<th>Session IV</th>
<th>Session V</th>
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</thead>
<tbody>
<tr>
<td>Real-size VB</td>
<td>INCREMENTS OF BMI</td>
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</table>

**POST-ASSESSMENT SESSION (1h)**

<table>
<thead>
<tr>
<th>Experimental group</th>
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<tbody>
<tr>
<td>1. Photography procedure (real-size VB at the post-assessment)</td>
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<td>2. AN measures</td>
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<tr>
<td>3. Anxiety-VASs were asked every 120 seconds throughout the exposure session. Aim: Reduce the initial level of anxiety by 40% with respect to the whole body.</td>
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<tr>
<td>4. VR-relaxation environments the last five minutes of each session.</td>
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<tr>
<td>5. Visomotor and viso-tactil FBI procedures.</td>
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<td>6. VASs 0-100 (FGW, Body anxiety, FBI)</td>
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**FOLLOW-UP AT 3 Months**

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**Figure 1.** Participant flow throughout the study and the experimental design of the study.
PROCEDURE
CREATING THE REAL-SIZE VIRTUAL BODY
VIRTUAL ENVIRONMENT
FULL BODY OWNERSHIP ILLUSION

VISUO-MOTOR STIMULATION PROCEDURE

VISUO-TACTILE STIMULATION PROCEDURE
VR technology offers the possibility of performing body exposure therapy by allowing the patients to experience the illusion of ownership of a virtual body that progressively increases their weight until reach a healthy body mass index.
RESULTS: fear of gaining weight

Means of the experimental and control groups in the three assessment conditions (pre-assessment, post-assessment, three months follow-up) in Fear of gaining weight assessed with the EDI-DT questionnaire and a Visual analogic scale.
RESULTS: body dissatisfaction

Means of the experimental and control groups in the three assessment conditions (pre-assessment, post-assessment, three months follow-up) in Body dissatisfaction assessed with the EDI-BD and BIAS-BD questionnaire
Means of the experimental and control groups in the three assessment conditions (pre-assessment, post-assessment, three months follow-up) in Body distortion assessed with the BIAS-BD questionnaire.

The weight gain of the avatar spread across the sessions allowed realistic weight increases, helping patients internalize the changes in their real bodies after the intervention.
RESULTS: body anxiety – drive for thinness

Means of the experimental and control groups in the three assessment conditions (pre-assessment, post-assessment, three months follow-up) in Body anxiety assessed with the PASTAS questionnaire and in Drive for thinness assessed with the EDI-DT questionnaire.
RESULTS: body appreciation – body max index

Means of the experimental and control groups in the three assessment conditions (pre-assessment, post-assessment, three months follow-up) in Body appreciation assessed with the BAS questionnaire and in BMI.
VR-based body exposure therapy can improve the effectiveness of CBT for AN reducing negative body-related responses, not only when the patients are exposed to their real body but also when they are exposed to a virtual representation of their body with a certain amount of weight gain.
Body-related Attentional Bias (AB)

Patients with AN show an AB for weight-related body parts and parts of their body that they consider unattractive.
The combination of virtual reality and eye-tracking devices allows to generate ecologically valid settings by simulating real-life situations, in highly controlled situations while objective indicators of attentional patterns are recorded in an accurate and objective way.
Body-related AB: assessment

Body-related AB is recorded by determining the participants’ visual fixation on their own bodies.

Visual fixation is an involuntary act of maintaining the gaze on a specific location, at least, for 100–200 milliseconds.
Body-related AB

Association with higher levels of body dissatisfaction

Interference with the effectiveness of body exposure-based treatments
Higher levels of body-related AB at pre-treatment were strongly associated with poorer outcomes after the intervention

- lower reduction of fear of gaining weight
- lower reduction of body dissatisfaction
- lower increase of body appreciation
ATTENTIONAL BIAS MODIFICATION TRAINING (ABMT)

Attentional bias modification training has been considered a promising and effective intervention tool to reduce attentional bias.

Attentional bias modification training is a form of cognitive bias modification, i.e., a variety of computer-based tasks designed to manipulate cognitive processes modifying cognitive biases that preferentially process disorder-congruent information via repetition of simple tasks.

The most widely used technique in the area of visual attention to correct AB is the modified probe detection task.
The task is based on a virtual reality adaptation of the attentional bias induction procedure proposed by Smeets et al. 2011.
ABMT BASED ON VR AND ET IN AN PATIENTS: a pilot study

**Sample**
23 AN females and adolescents aged 12 - 17 years

**Hypothesis**
by balancing attention between weight and non-weight related body areas, the ABMT will reduce dysfunctional body-related AB and will also reduce BD levels

Means of the experimental and control groups in the two assessment conditions (pre-assessment and post-assessment) in AB and Body dissatisfaction assessed with the BIAS-BD questionnaire
SYMPTOM CHANGES ARE AFFECTED BY CHANGES IN ATTENTIONAL BIAS

ABMT REDUCE ATTENTIONAL BIAS
ON-GOING STUDY:
ABMT, through VR, to improve the treatment of AN

ABMT COULD REPRESENT A USEFUL WAY TO IMPROVE BODY EXPOSURE THERAPIES IN AN

Incorporate the ABMT within Mirror exposure therapy

MAIN OBJECTIVE increasing the efficacy of virtual body-exposure treatment by previously reducing the attentional bias
ON-GOING STUDY:
ABMT, through VR, to improve the treatment of AN
By adding a prior modification of AB to MET, the patient is expected to have more distributed attention that is not biased toward particular body parts so as to intensify the effects of MET.
Expected results

We expect the experimental group to have better results than the control groups

Reduction in:
- Attentional bias
- Body Image disturbances
- Thinness obsession
- Body anxiety

Increase in:
- Body Mass Index
- Body appreciation
In addition to CBT, the use of VR technology might improve clinical practice in AN by providing new tools to help patients confront their core fears and improve their emotional, cognitive, and behavioral responses to their body image as well as other important eating disorder symptoms.

VR body exposure procedures could have promising future applications in the field of eating disorders and body image disturbances.
Thanks for your attention!

Contacts
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