

2nd Brain & Mind Conference

SJD Barcelona Children's Hospital

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.

Body image distortion



Body image dissatisfaction



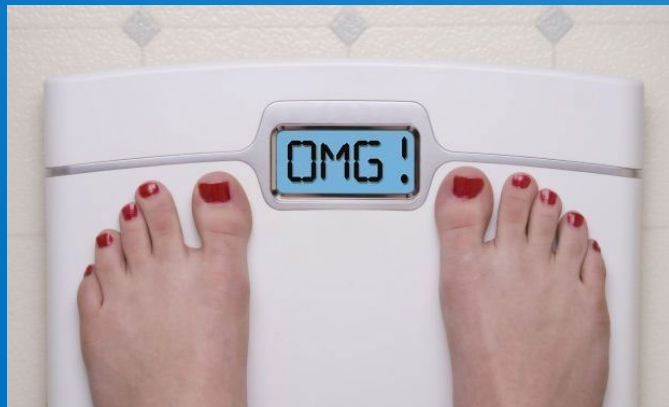
Fear of gaining weight

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



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



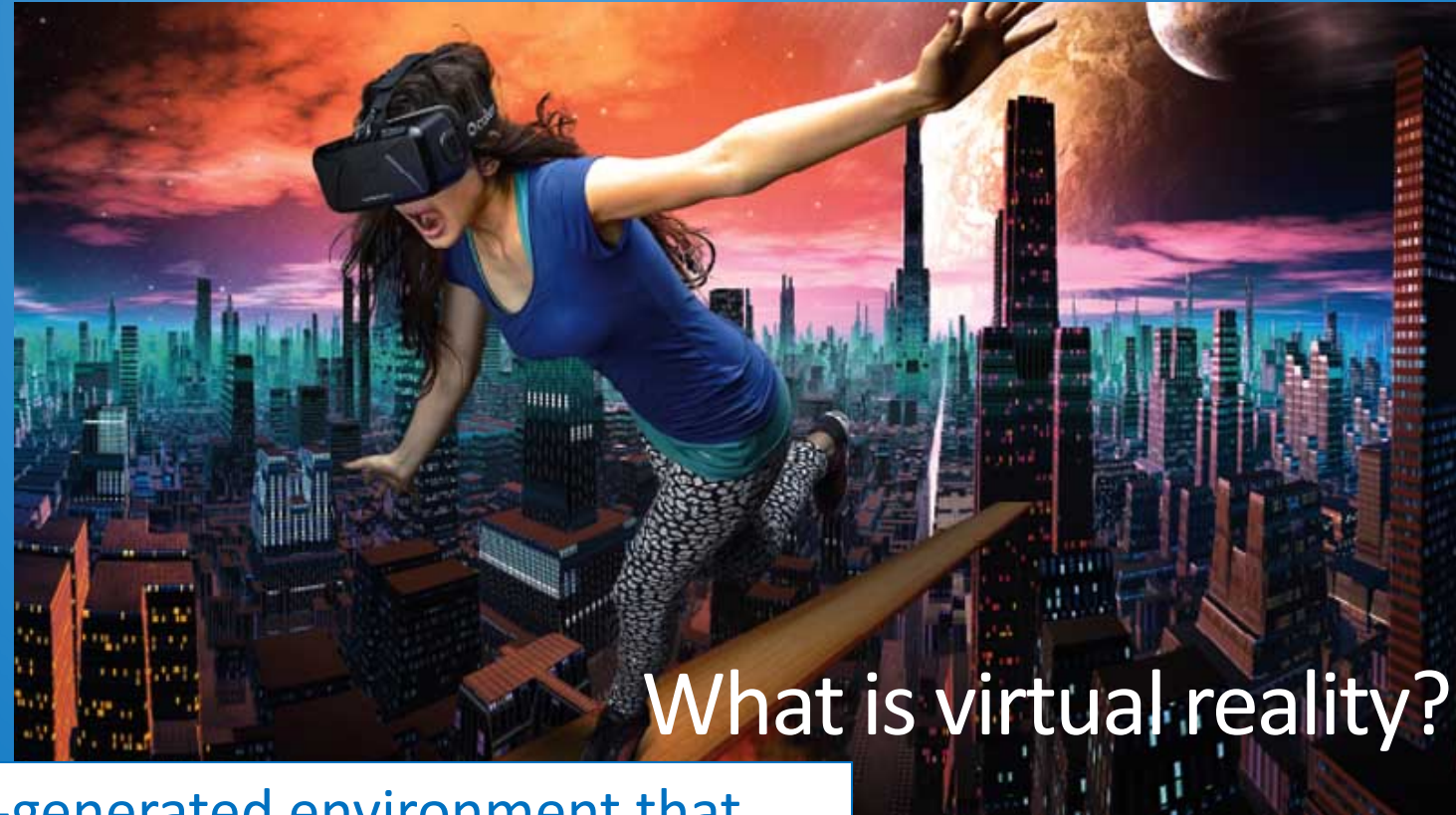
IMAGINATIVE DIFFICULTIES

KEEPING EXPOSURE SUFFICIENTLY VIVID OVER TIME

AVOIDANCE STRATEGIES

LACK OF REALISM

VIRTUAL REALITY (VR)-BASED EXPOSURE TECHNIQUES MAY OVERCOME THESE LIMITATIONS



What is virtual reality?

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

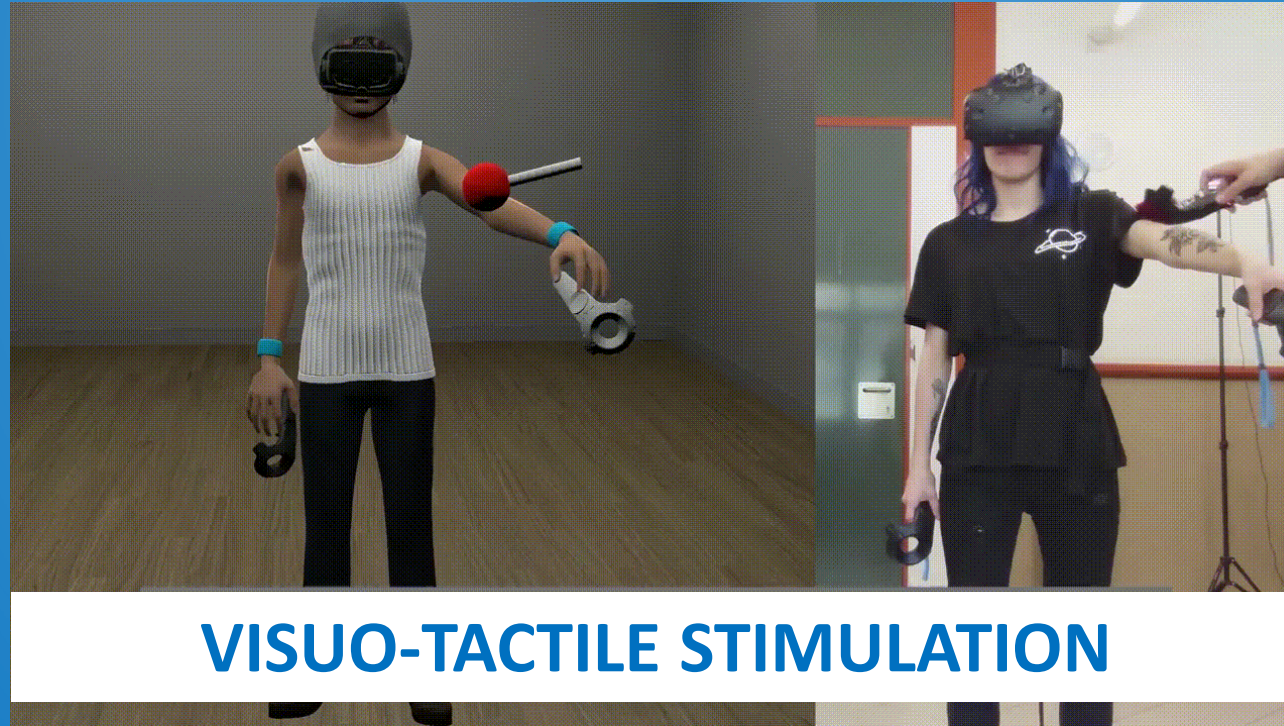
FULL-BODY ILLUSION PROCEDURES



VISUO-MOTOR STIMULATION

Synchronizing the movement of the participant and the avatar using motion capture sensors placed on hands and feet

FULL-BODY ILLUSION PROCEDURES



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*

Article

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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Abstract: In vivo body exposure therapy is considered an effective and suitable intervention to help patients with anorexia nervosa (AN) reduce their body image disturbances (BIDs). However, these interventions have notable limitations and cannot effectively reproduce certain fears usually found in AN, such as the fear of gaining weight (FGW). The latest developments in virtual reality (VR) technology and embodiment-based procedures could overcome these limitations and allow AN patients to confront their FGW and BIDs. This study aimed to provide further evidence of the efficacy of an enhanced (by means of embodiment) VR-based body exposure therapy for the treatment of AN. Thirty-five AN patients (16 in the experimental group, 19 in the control group) participated in the study. FGW, BIDs, and other body-related and ED measures were assessed before and after the intervention and three months later. The experimental group received treatment as usual (TAU) and five additional sessions of VR-based body exposure therapy, while the control group received only TAU. After the intervention, ED symptoms were clearly reduced in both groups, with most of the changes being more noticeable in the experimental group. Specifically, after the intervention and at follow-up, significant group differences were found in the FGW and BIDs, with the experimental group showing significantly lower values than the control group. The current study provides new insights and encouraging findings in the field of exposure-based therapies in AN. VR technology might improve research and clinical practice in AN by providing new tools to help patients confront their core fears (i.e., food- or weight-related cues) and improve their emotional, cognitive, and behavioral responses to their body image.

Keywords: eating disorders; virtual reality body exposure; fear of gaining weight; body image disturbances; anorexia nervosa



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

		Experimental Group N=16	Control Group N=19
Age, mean (SD)		18.25 (1.30)	19.21 (1.78)
Group Age, n (%)	Adolescents	9 (56.25)	12 (63.16)
	Adults	7 (43.75)	7 (36.84)
Sex, n (%)	Women	14 (87.5)	17 (89.47)
	Men	2 (12.5)	2 (10.52)
BMI, mean (SD)		17.30 (1.06)	17.54 (1.27)

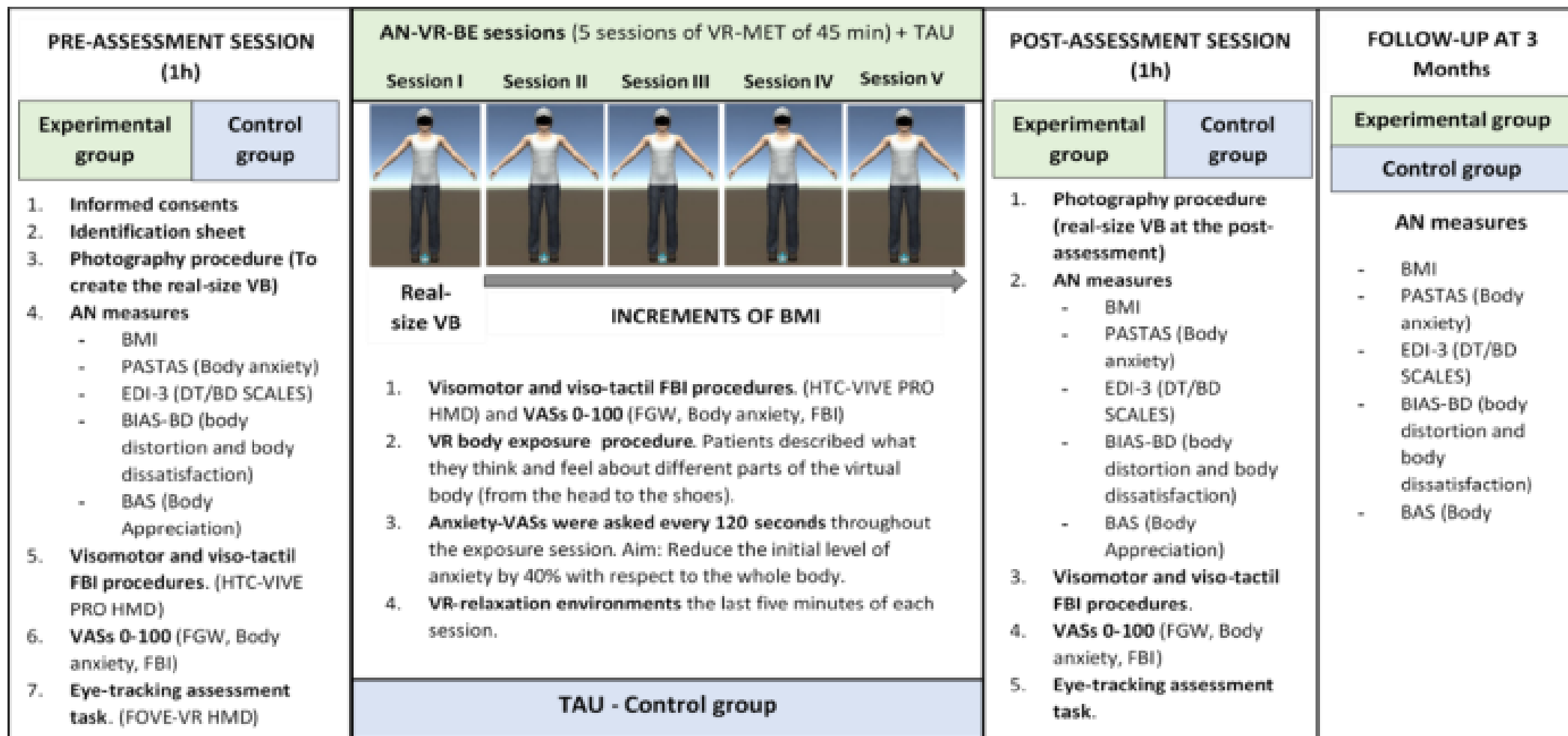
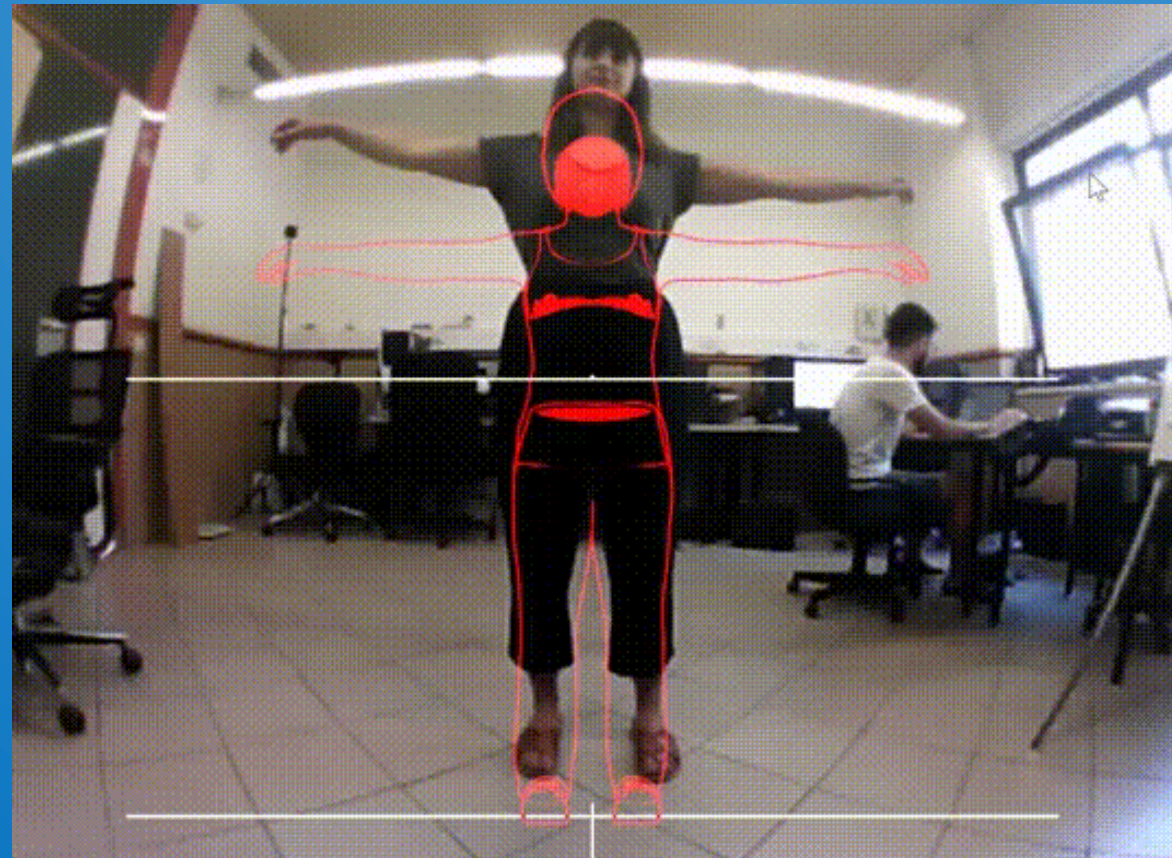


Figure 1. Participant flow throughout the study and the experimental design of the study.

PROCEDURE

CREATING THE REAL-SIZE VIRTUAL BODY



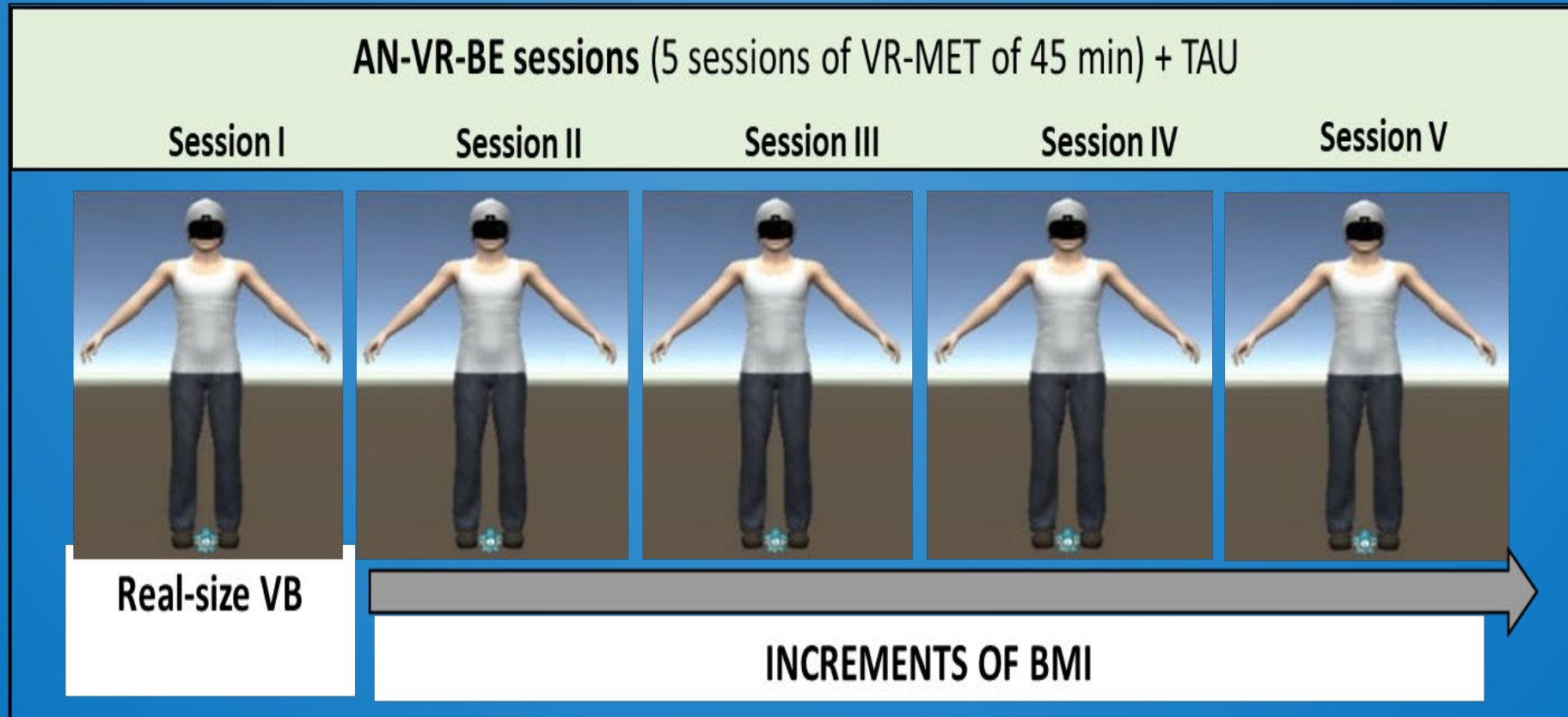
VIRTUAL ENVIROMENT



FULL BODY OWNERSHIP ILLUSION

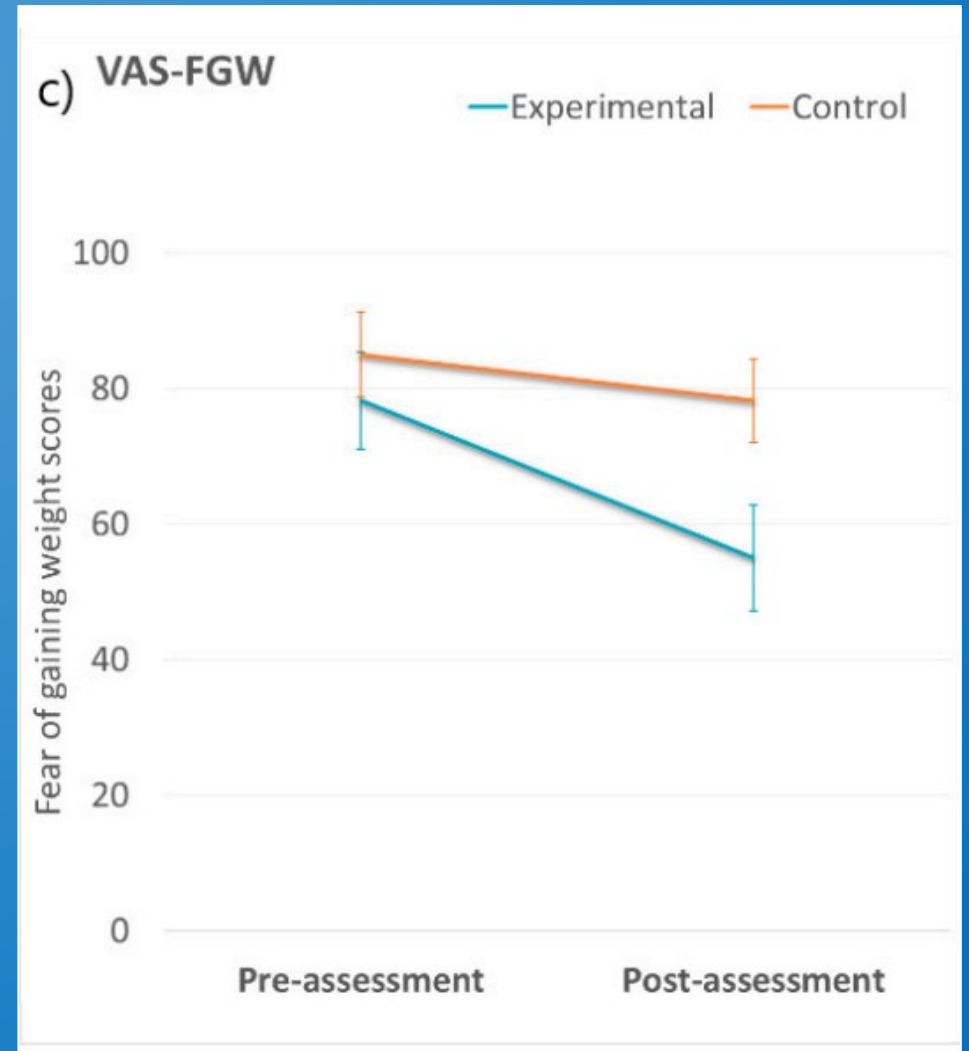
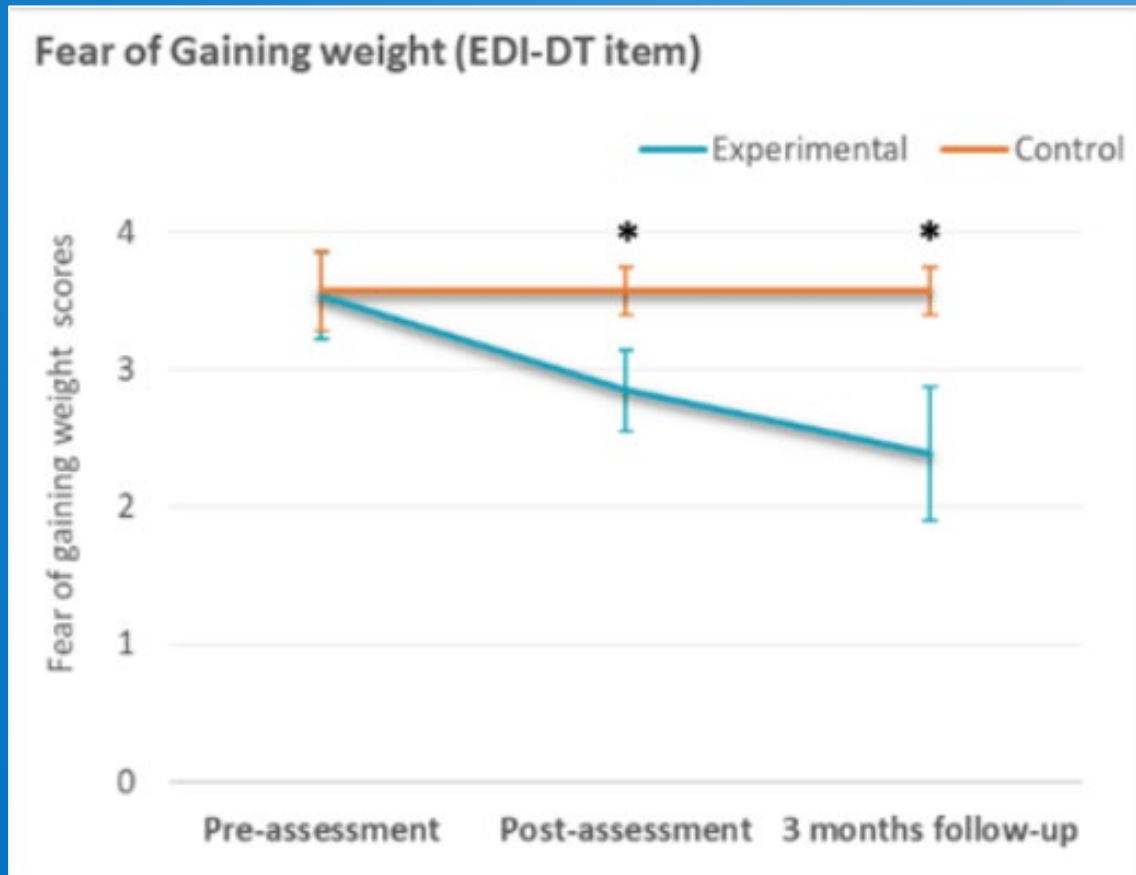


VR Body Exposure Sessions (Experimental Group)



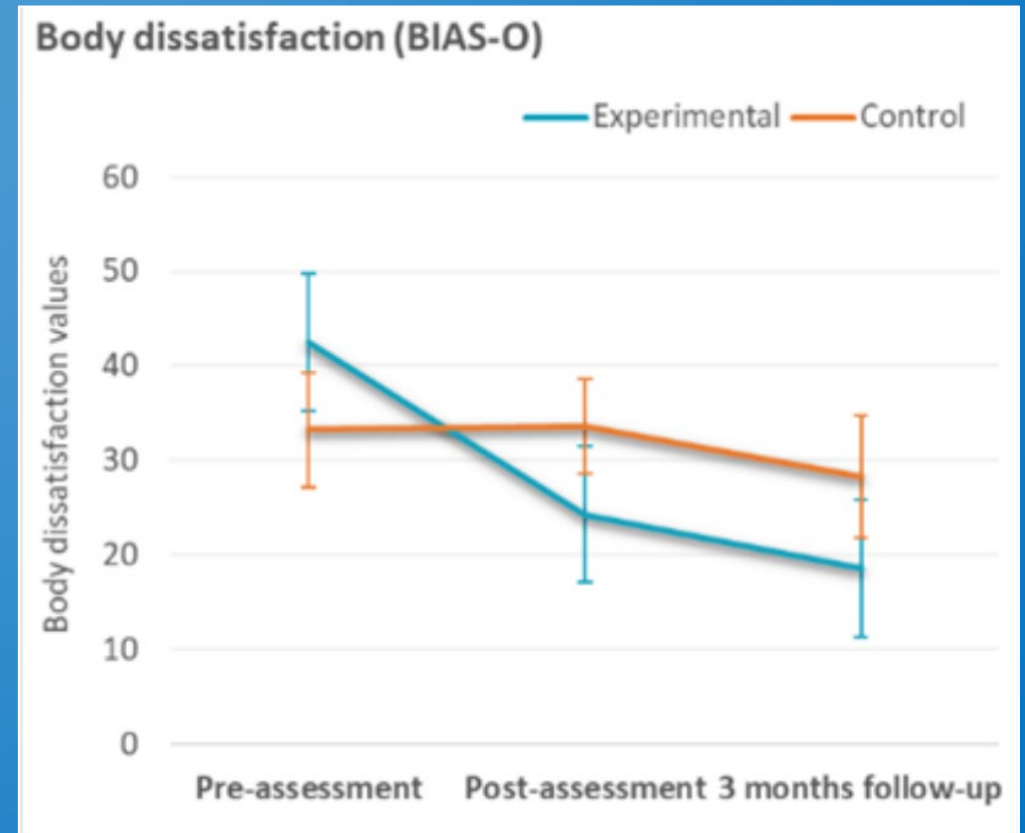
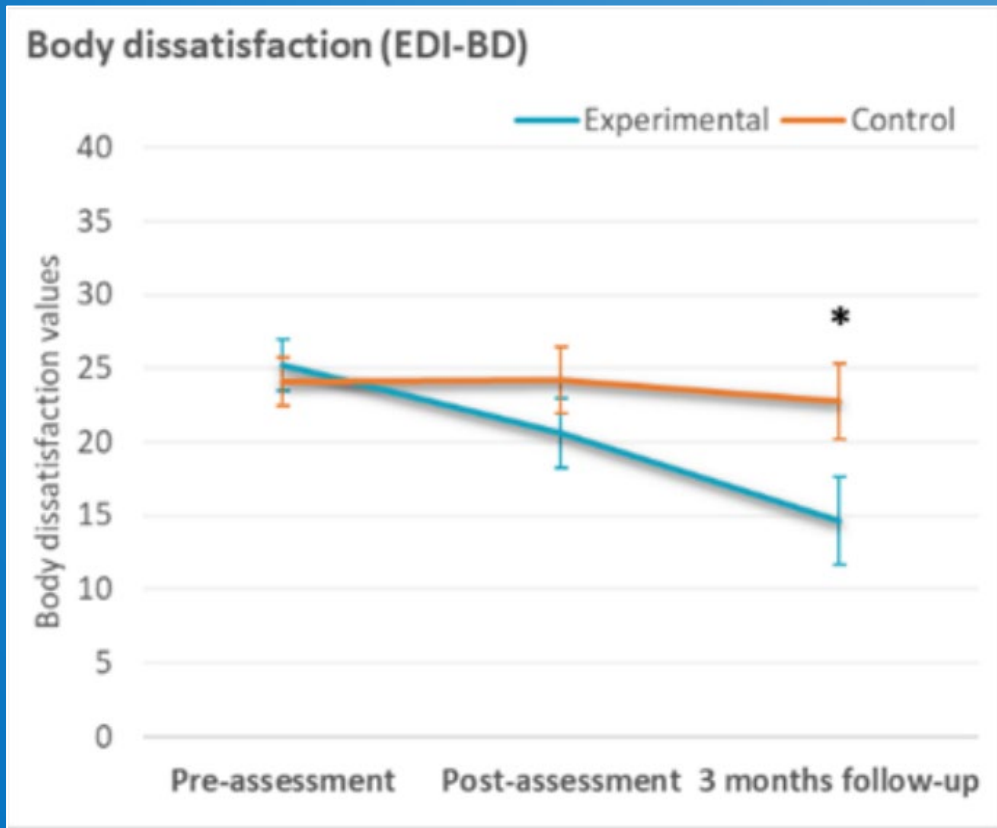
VR technology offers the possibility of performing body exposure therapy by allowing the patients to experience the illusion of ownership of a virtual body that progressively increases their weight until reach a healthy body mass index.

RESULTS: fear of gaining weight



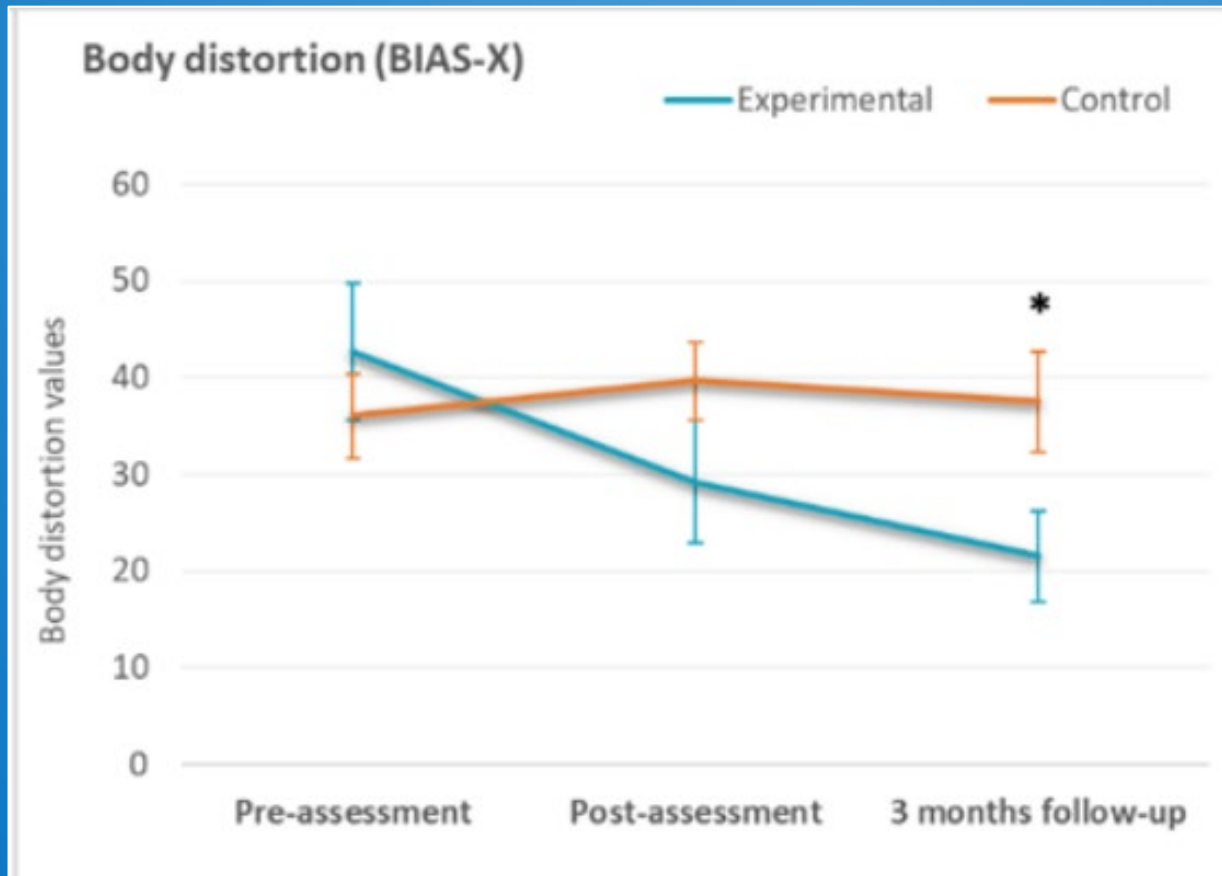
Means of the experimental and control groups in the three assessment conditions (pre-assessment, post-assessment, three months follow-up) in Fear of gaining weight assessed with the EDI-DT questionnaire and a Visual analogic scale.

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

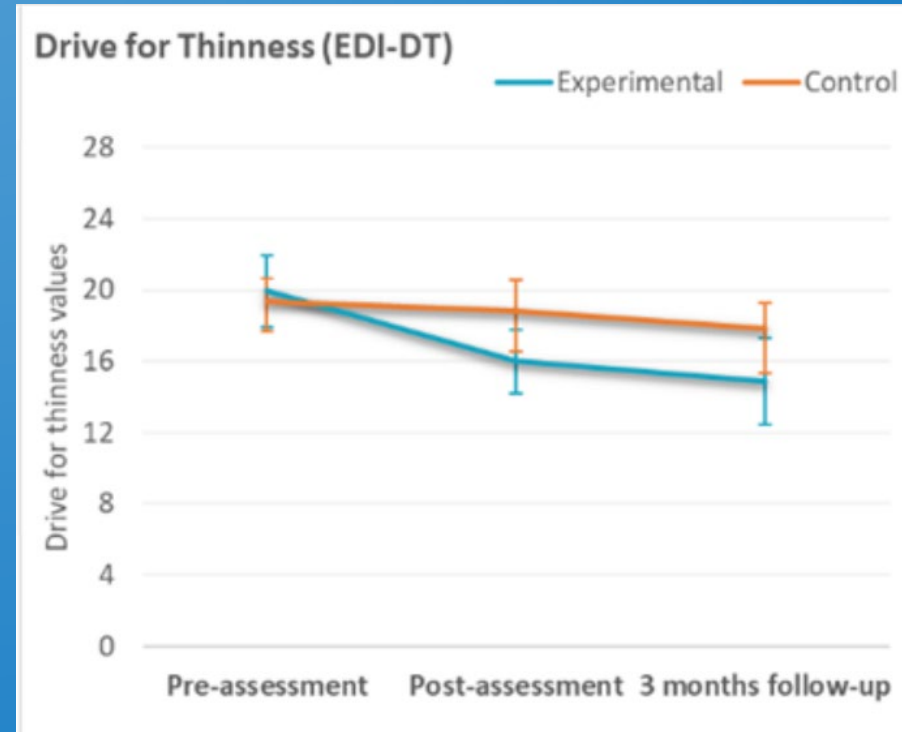
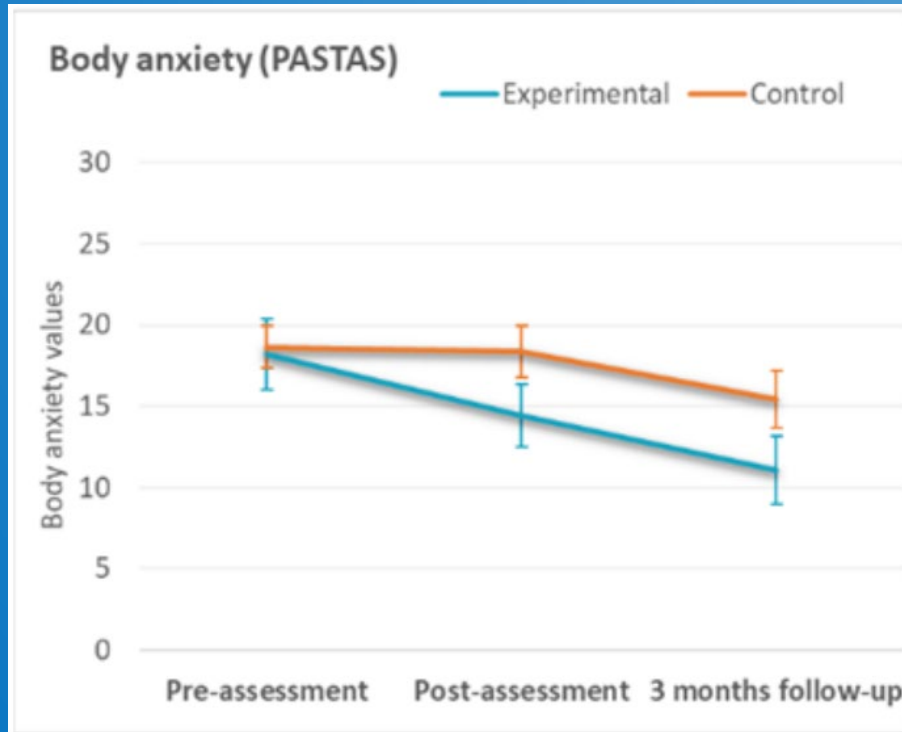
RESULTS: body distortion



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.

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

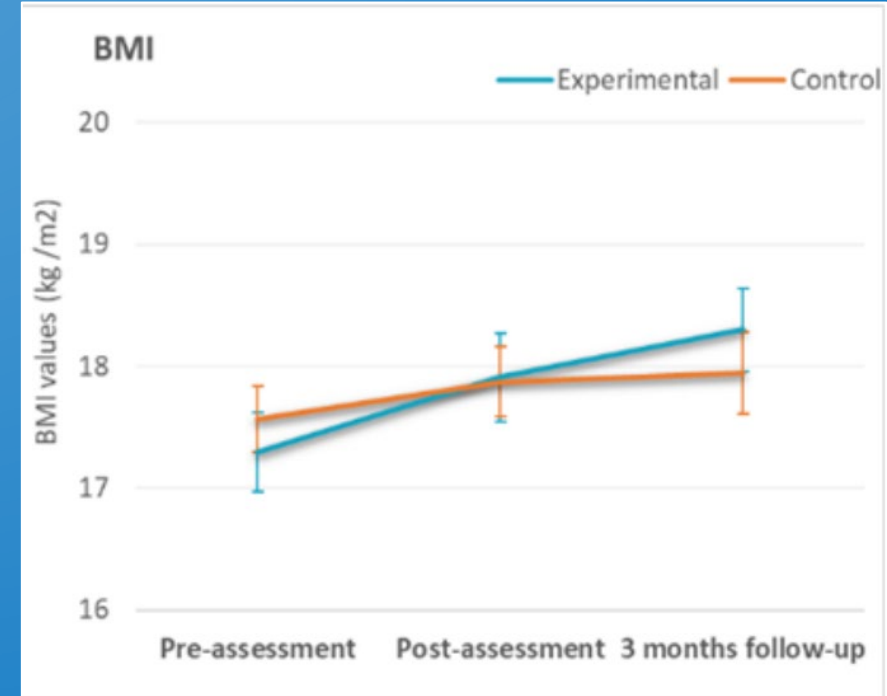
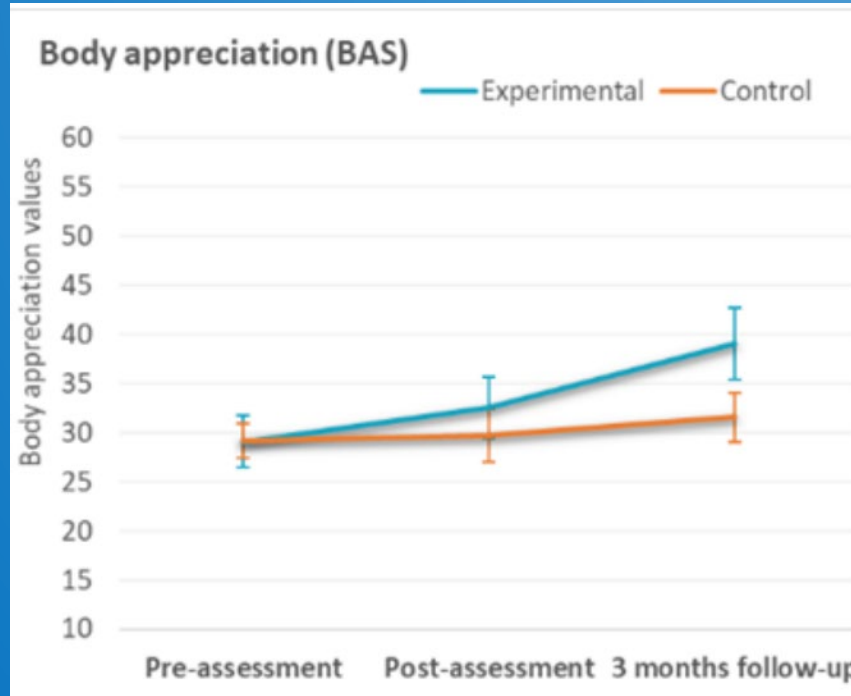
RESULTS: body anxiety – drive for thinness



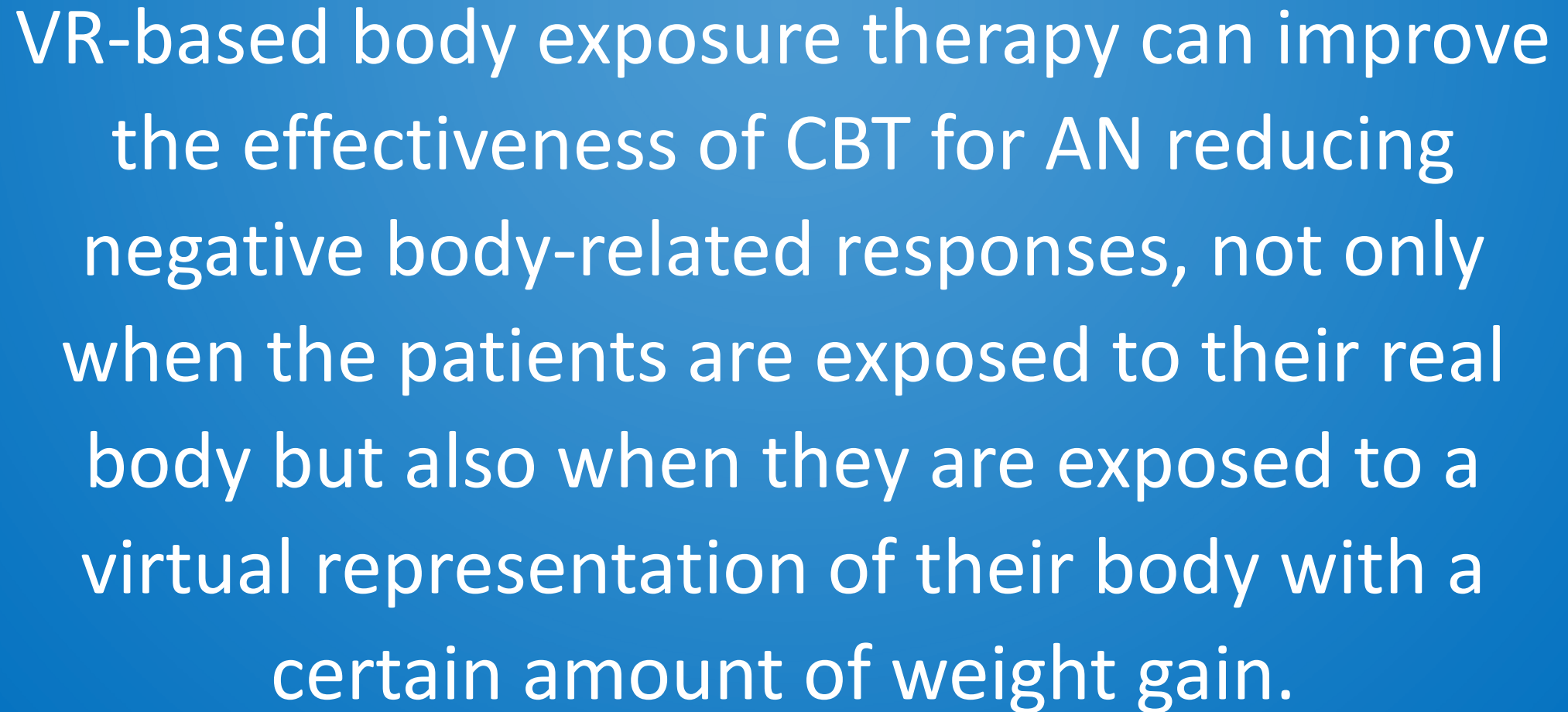
Means of the experimental and control groups in the three assessment conditions (pre-assessment, post-assessment, three months follow-up)

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

The image features a solid blue background with white decorative circuit-like lines in the corners. These lines consist of straight segments connected by small circles, resembling a network or data flow diagram. The lines are positioned in the top-left, top-right, bottom-left, and bottom-right corners, framing the central text.

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.

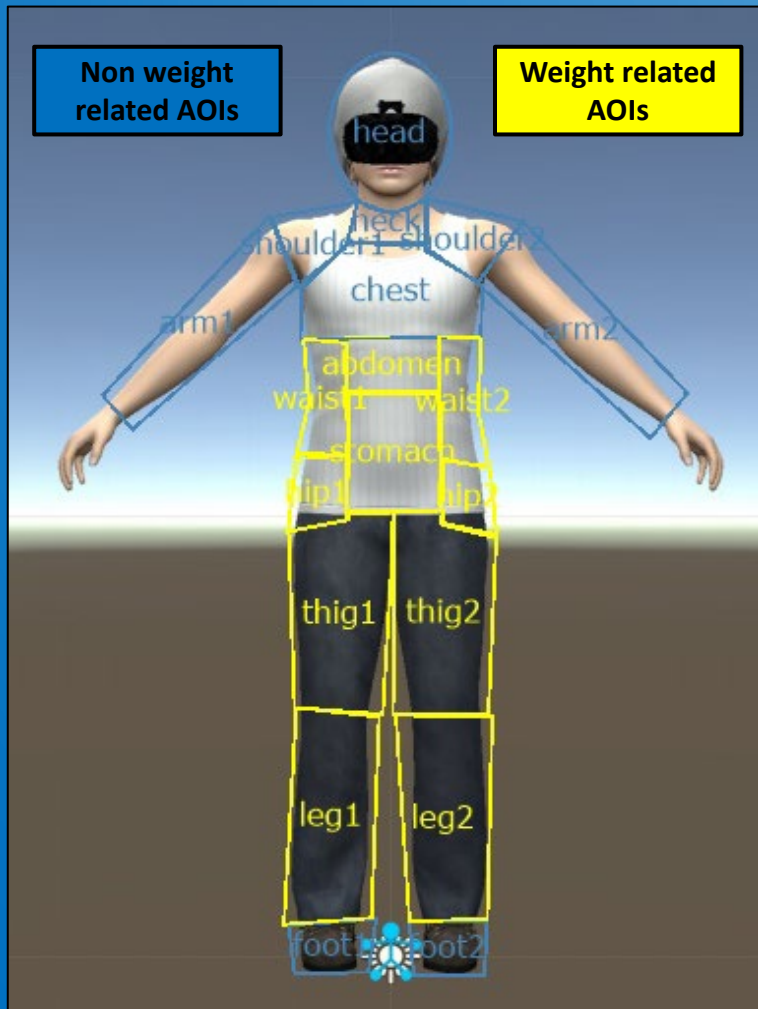
Body-related Attentional Bias (AB)

ATTENTIONAL BIAS



tendency to focus attention to stimuli related to the disease or perceived as threatening over other types of information

Patients with AN show an AB for weight-related body parts and parts of their body that they consider unattractive

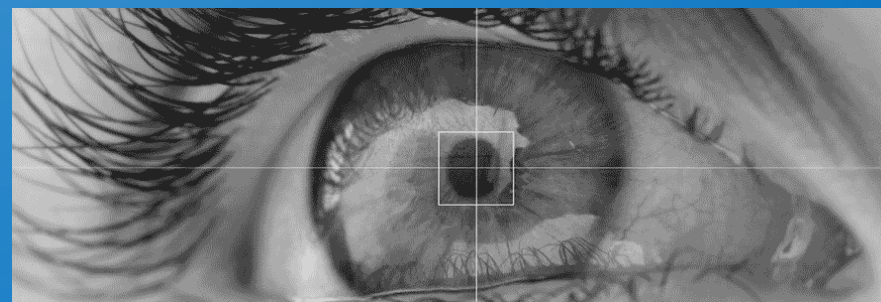
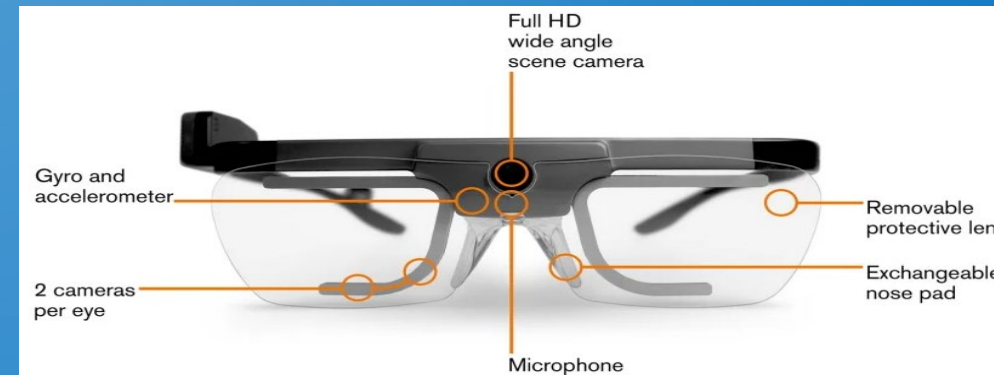


Body-related AB: assessment

Virtual reality



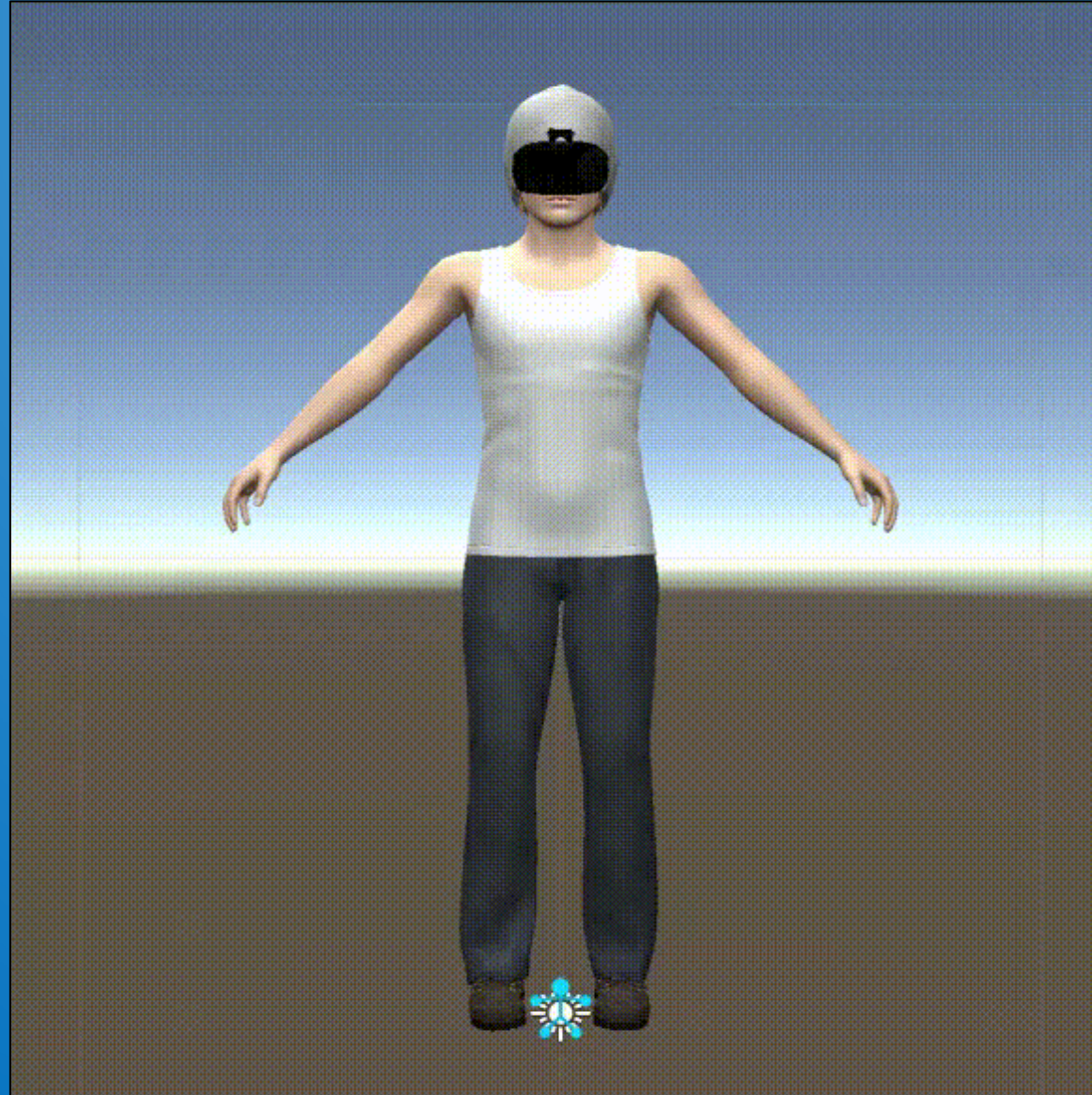
Eye-tracking (ET)



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



Body-related AB could interfere with the efficacy of exposure-based treatment

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

The way we look at our own body really matters! Body-related attentional bias as a predictor of worse clinical outcomes after a virtual reality body exposure therapy

Marta FERRER-GARCIA^{a1}, Bruno PORRAS-GARCIA^a, Helena MIQUEL^a, Eduardo SERRANO-TRONCOSO^b, Marta CARULLA-ROIG^b and José GUTIÉRREZ-MALDONADO^a

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Abstract: Body-related attentional bias (AB) experienced by anorexia nervosa (AN) patients has been associated with body image disturbances and other eating disorders (ED)-related symptoms. The aim of this study was to assess whether the body-related AB reported by AN patients before a virtual reality (VR)-based body exposure therapy predicted worse clinical outcomes after treatment. Thirteen AN outpatients participated in the study. AB was recorded using an eye-tracker incorporated in a VR-Head Mounted Display. Results showed that AN patients attended to their weight-related body parts for longer and more frequently than to their non-weight-related body parts. Statistically significant ($p < .05$) negative and positive correlations between pre-intervention body-related AB measures and the difference between pre- and post-assessment fear of gaining weight, body dissatisfaction, and body appreciation measures were also found. Showing higher body-related AB before the intervention marginally predicted a lower reduction of fear of gaining weight ($p = .08$ and $p = .07$) and body dissatisfaction ($p = .05$ and $p = .06$) at post-treatment, and significantly predicted a lower increase of body appreciation scores after the intervention ($p < .001$). Results suggest that body-related AB may reduce the efficacy of VR-based body exposure therapy in patients with AN.

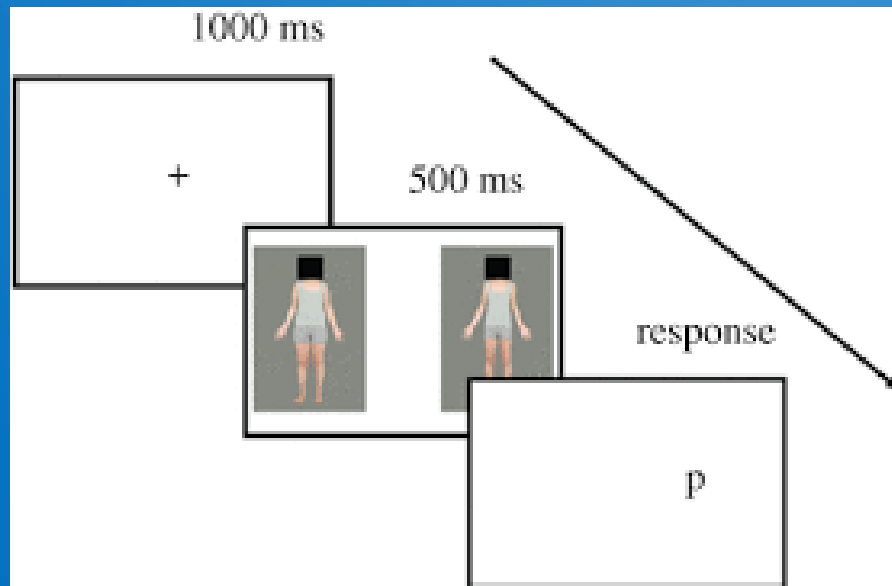
Keywords: Anorexia Nervosa, Body-Related Attentional Bias, Virtual Reality, Eye-Tracking, Body Exposure Therapy, Treatment Outcomes



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.

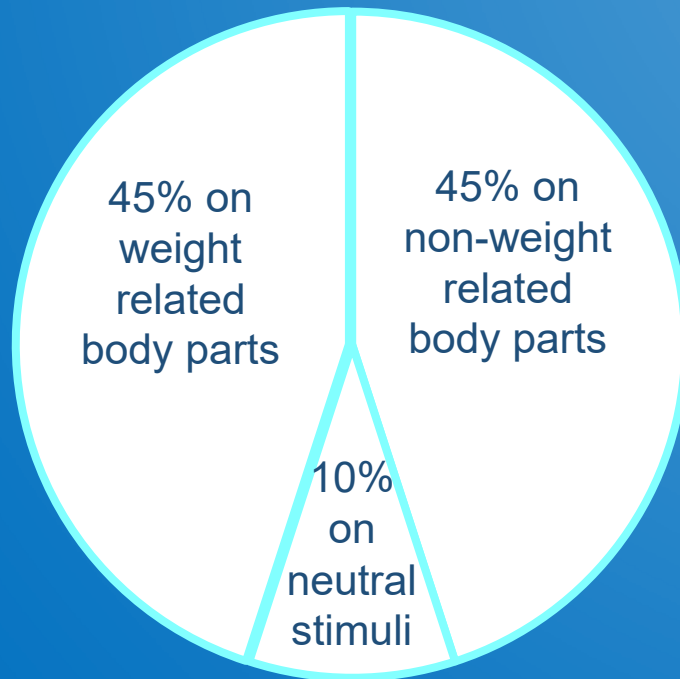


The most widely used technique in the area of visual attention to correct AB is the modified probe detection task

Limitations

VR and ET based Attentional Bias Modification Training

Reducing AB by balancing the attention between weight-related and non-weight-related body parts



150 figures divided into two blocks of 75 figure
10-15 minutes task

The task is based on a virtual reality adaptation of the attentional bias induction procedure proposed by Smeets et al. 2011

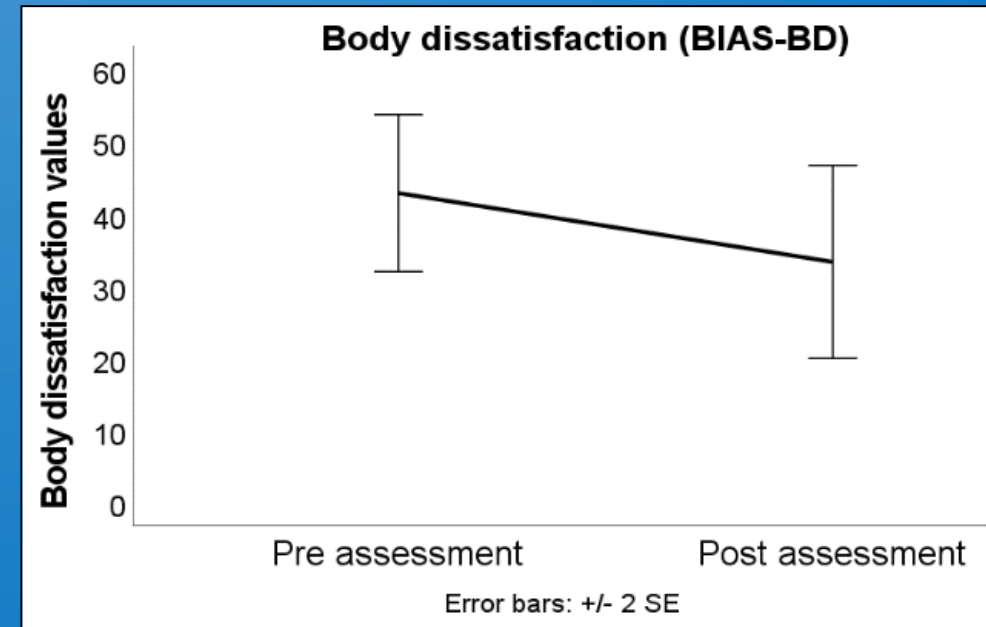
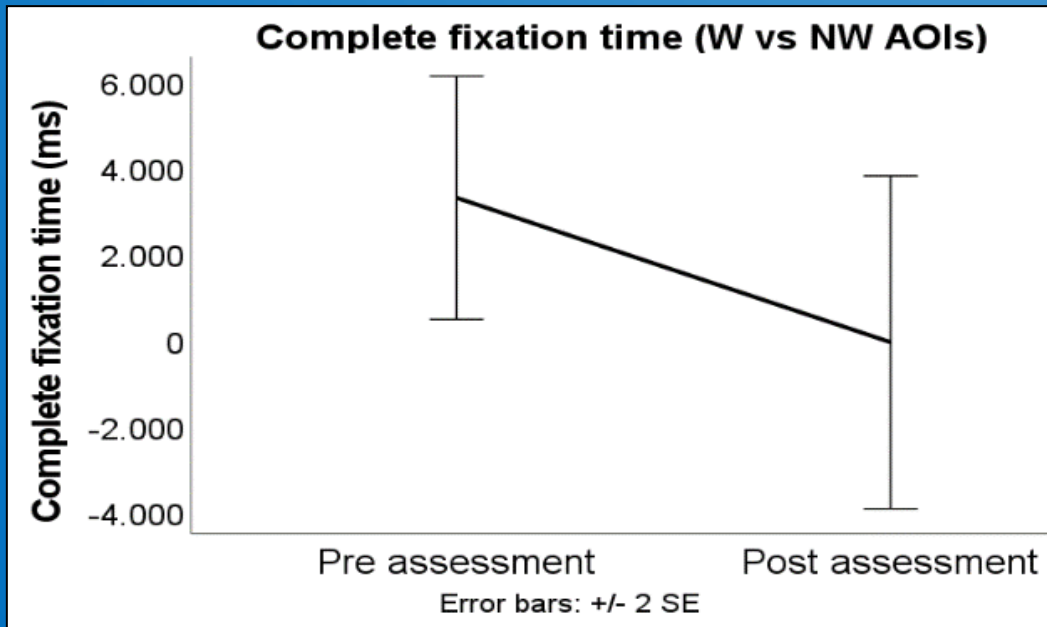


ABMT BASED ON VR AND ET IN AN PATIENTS: a pilot study



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

ABMT BASED ON VR AND ET IN AN PATIENTS: a pilot study

**ABMT REDUCE
ATTENTIONAL BIAS**

**SYMPTOM CHANGES ARE
AFFECTED BY CHANGES IN
ATTENTIONAL BIAS**

ON-GOING STUDY:

ABMT, through VR, to improve the treatment of AN

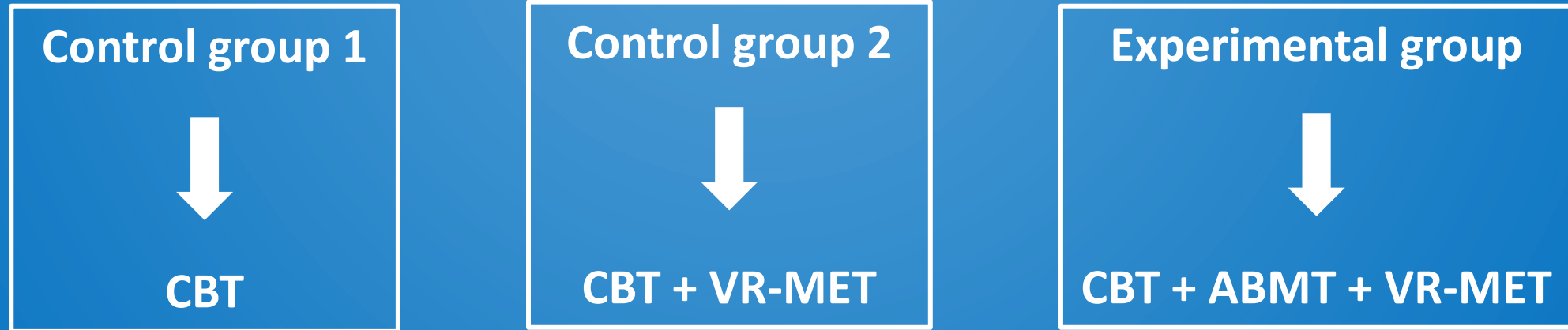
ABMT COULD REPRESENT A USEFUL WAY
TO IMPROVE BODY EXPOSURE THERAPIES IN AN

**Incorporate the ABMT
within Mirror exposure therapy**

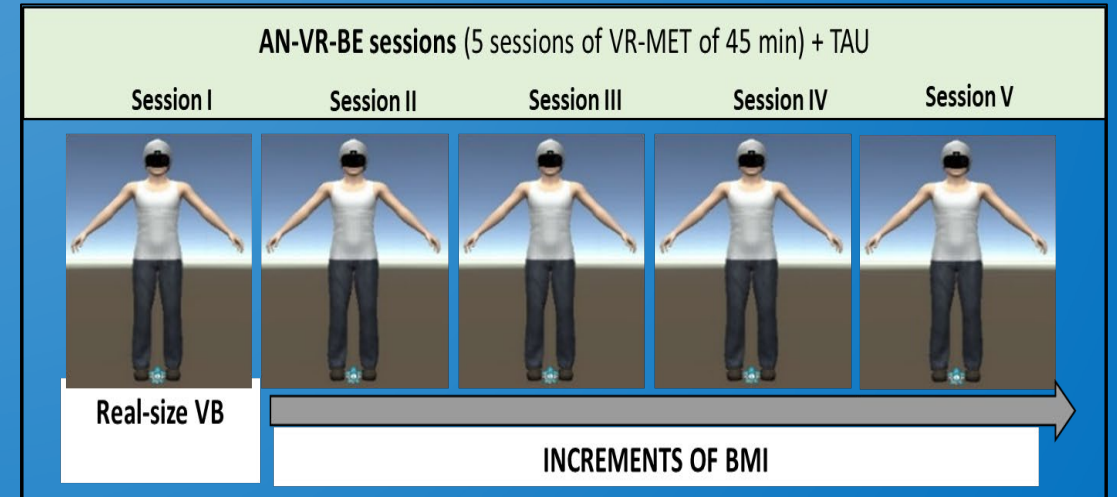
MAIN OBJECTIVE → increasing the efficacy of virtual body-exposure treatment by previously reducing the attentional bias

ON-GOING STUDY:

ABMT, through VR, to improve the treatment of AN



Experimental sessions: ABMT+VR Body Exposure



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:

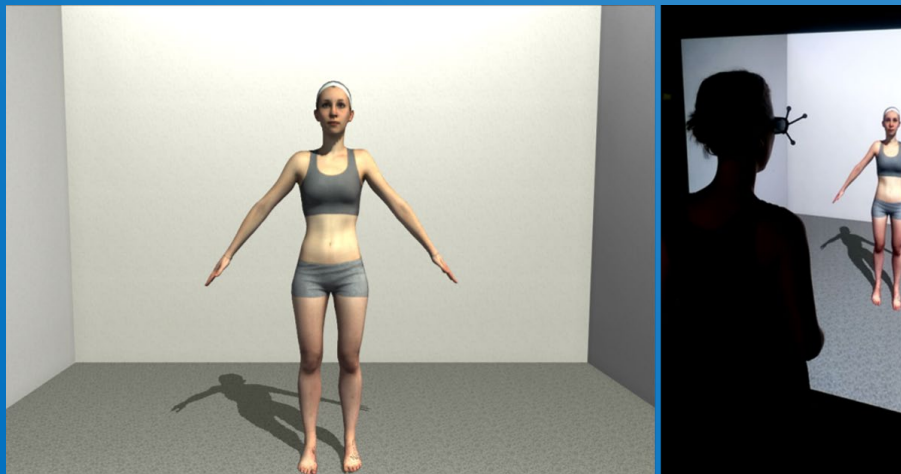
- Attentional bias
- Body Image disturbances
- Thinness obsession
- Body anxiety

Increase in:

- Body Mass Index
- Body appreciation

CONCLUSIONS

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.

2nd Brain & Mind Conference

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Thanks for your attention!

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