

Virtual Reality in Mental Health

November 9 & 10, 2023
University Medical Center, Groningen

New Horizons



VRMentalHealth.nl/en/conference

Virtual reality-based attentional bias modification training to improve the efficacy of mirror exposure therapies.

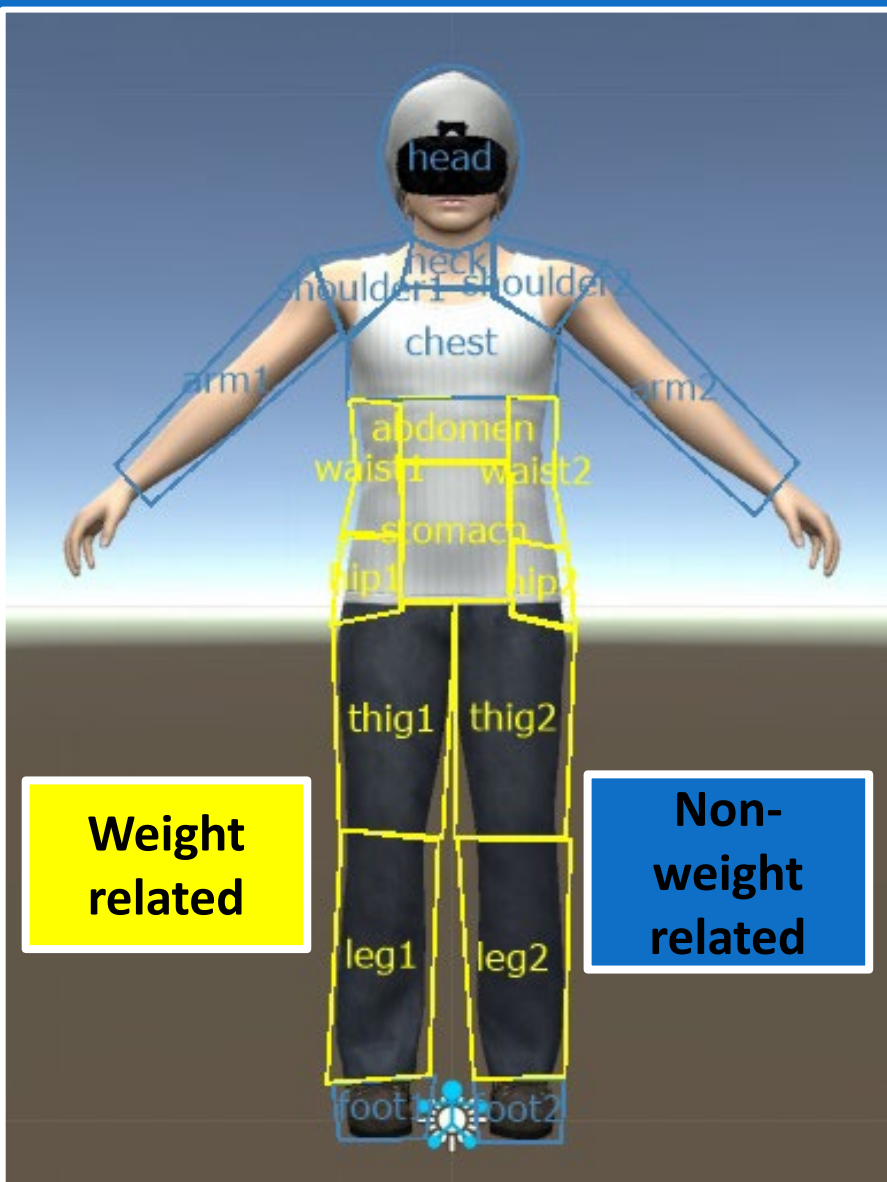
***User experience optimization with healthy women
and preliminary results with patients with anorexia nervosa.***

Franck Alexandre MESCHBERGER-ANNWEILER ¹, Mariarca ASCIONE ¹, Marta CARULLA-ROIG ²,
Helena MIQUEL-NABAU ¹, Eduardo SERRANO-TRONCOSO ², Marta FERRER-GARCIA ¹
and Jose GUTIERREZ-MALDONADO ¹

¹ Department of Clinical Psychology and Psychobiology, Institute of Neurosciences, University of Barcelona, Passeig de la Vall d'Hebron 171, 08035 Barcelona, Spain

² Department of Child and Adolescent Psychiatry and Psychology, Hospital Sant Joan de Deu of Barcelona, Passeig de Sant Joan de Deu, 2, Esplugues de Llobregat, 08950 Barcelona, Spain

Patients with anorexia nervosa show dysfunctional body-related attentional bias



Physical Appearance State and Trait Anxiety Scale (PASTAS; Thompson, 1999)

Body-related attentional bias



Virtual Reality
Mental Health



Association with
higher levels
of **body
dissatisfaction**

Interference with
the effectiveness of
the **body
exposure-based
treatments**



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.

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^b

^a Department of Clinical Psychology and Psychobiology, Universitat de Barcelona.

^b Department of Child and Adolescent Psychiatry and Psychology, Hospital Sant Joan de Déu of Barcelona.

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

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**

Virtual Reality and Embodied Medicine

New opportunities for research and treatment of Eating Disorders

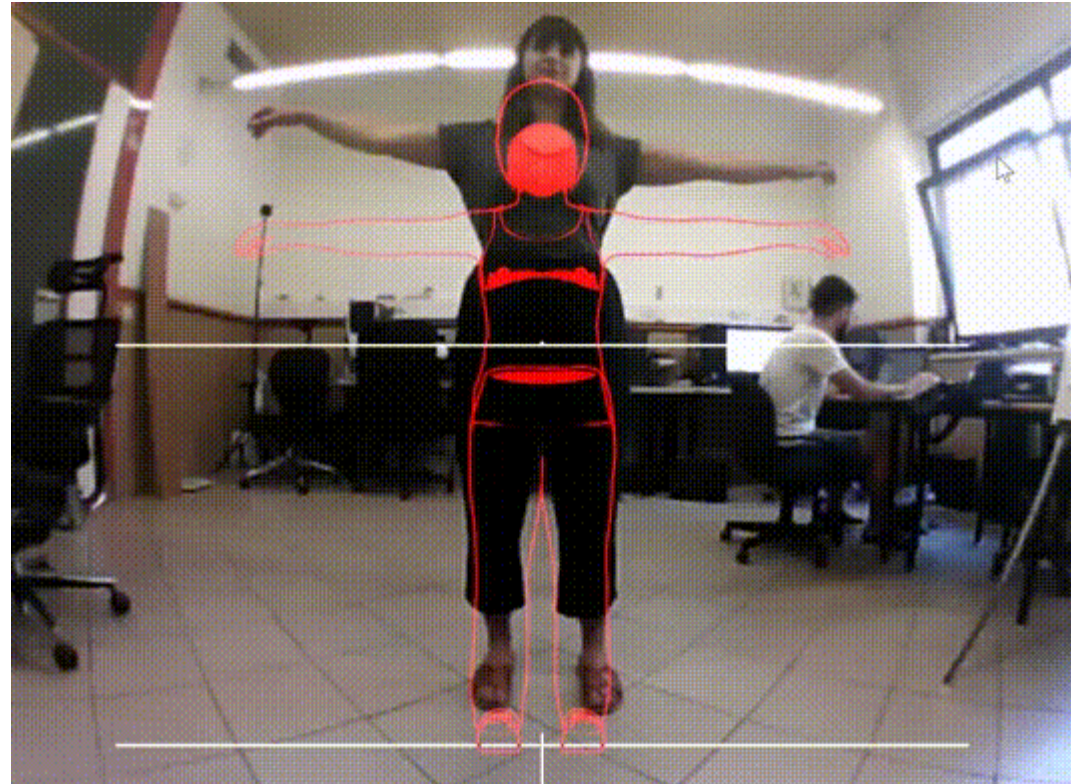


Virtual reality (VR) enables researchers and therapists to:

- **create highly realistic simulations** of real-life settings and situations associated with body and weight concerns.
- **design 3D avatars** that reproduce the patients' silhouettes based on their own body size, height, skin tone and clothes and capable of moving the same way as the individuals (**full-body motion tracking**) [1].



Creating a personalized avatar: photo procedure



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.

Full-Body Illusion Paradigm

Using a VR embodiment-based procedure allows individuals to realistically **experience a virtual body as their own body**, eliciting the same sensorial responses or activating the same implicit or explicit multisensory representations of their own body.

New transdisciplinary research field: the “embodied medicine”, aiming to use advanced technologies to alter the experience of being in a body in order to improve the health and wellbeing [2-5].



[2] Riva, G.; Serino, S.; Di Lerna, D.; Pavone, E.F.; Dakanalis, A. Embodied medicine: Mens sana in corpore virtuale sano. *Front. Hum. Neurosci.* **2017**, *11*, 120.

[3] Riva, G.; Wiederhold, B.K.; Mantovani, F. Neuroscience of Virtual Reality: From Virtual Exposure to Embodied Medicine. *Cyberpsychol. Behav. Soc. Netw.* **2019**, *22*, 82–96.

[4] Riva, G. The neuroscience of body memory: From the self through the space to the others. *Cortex* **2018**, *104*, 241–260.

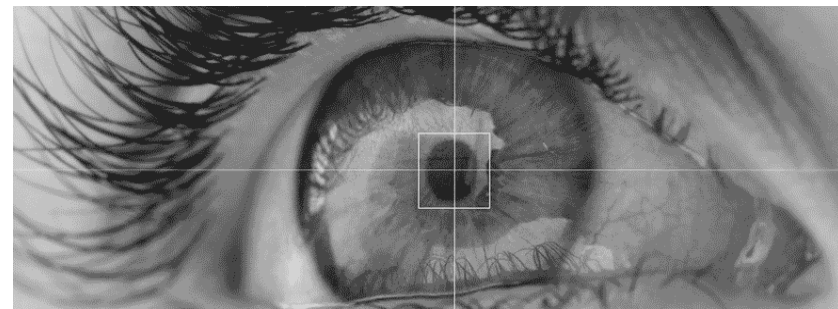
[5] Matamala-Gomez, M.; Maselli, A.; Malighetti, C.; Realdon, O.; Mantovani, F.; Riva, G. Body Ownership Illusions for Mental Health: A Narrative Review. *J. Clin. Med.* **2021**, *10*, 139.

Combined use of Virtual Reality and Eye-Tracking

Eye-Tracking feature integrated in the VR Head Mounted Displays (HMD) enables researchers to:

- **directly and continuously** record participants' saccades toward visual stimuli in **real time** [6].
- get a **detailed, direct and objective assessment** of the attentional patterns, bringing out avoidance and engagement with stimuli over time (e.g., with food-cue or specific body parts of participants).

ET-based methods are **ecologically valid**, as they can be used to study the attentional patterns on a more naturalistic visual array in comparison with other methods (stroop task or dot probe) [7].



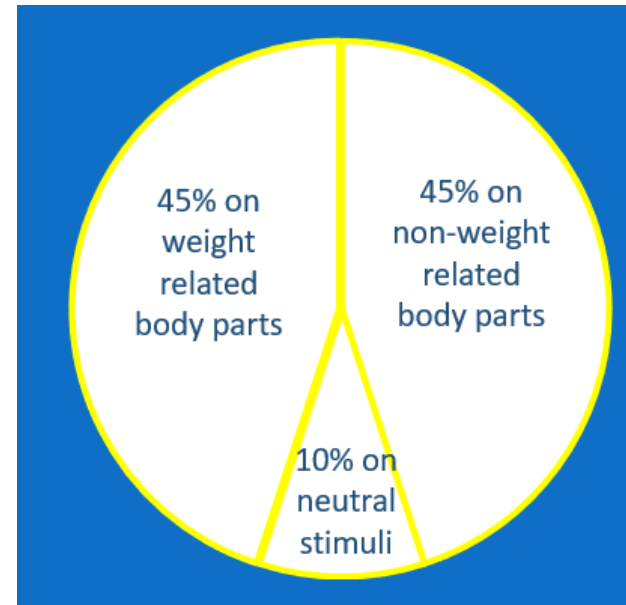
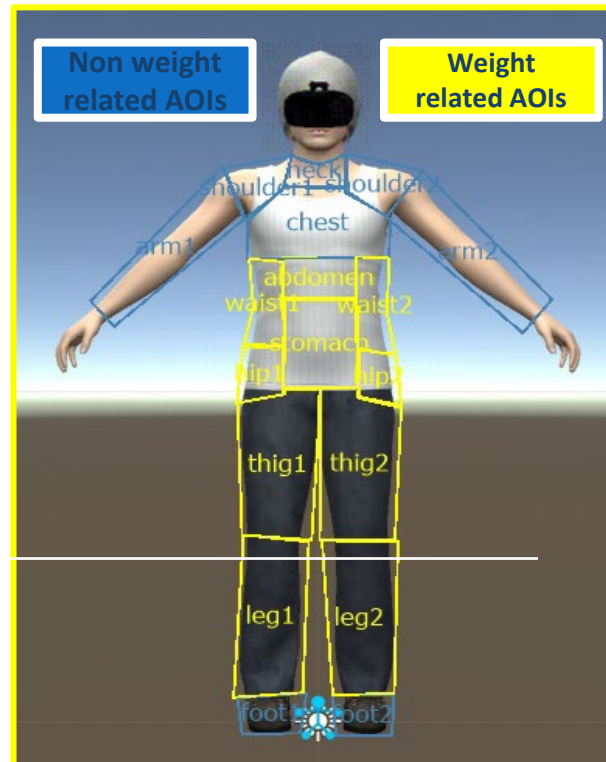
[6] Armstrong, T.; Olatunji, B.O. Eye tracking of attention in the affective disorders: a meta-analytic review and synthesis. *Clin Psychol Rev.* **2012**, 32(8), 704-23.

[7] Kerr-Gaffney, J.; Harrison, A.; Tchanturia, K. Eye-tracking research in eating disorders: A systematic review. *International Journal of Eating Disorders* **2019**, 52(1), 3–27.

First VR-based Attentional Bias Modification Task

- Adapted to VR from Smeets et al. (2011) [8].
- Projection of geometric figures in a balanced way between weight and non-weight related body areas (defined from PASTAS questionnaire) [9].

Areas Of Interest*



[8] Smeets, E.; Jansen, A.; Roefs, A. Bias for the (un)attractive self: On the role of attention in causing body (dis)satisfaction. *Health Psychology* **2011**, 30(3), 360–367

[9] Reed, D.L.; Thompson, J.K.; Brannick, M.T.; Sacco, W.P. Development and validation of the physical appearance state and trait anxiety scale (PASTAS). *J. Anxiety Disord.* **1991**, 5, 323–332.



Project purpose

Increasing the efficacy of Mirror Exposure Therapies (MET) by incorporating Attentional Bias Modification Task (ABMT) into MET in the treatment of women with anorexia nervosa (AN)

Will the mirror exposure treatment's efficacy increase by previously reducing the attentional bias?



First step: pilot study

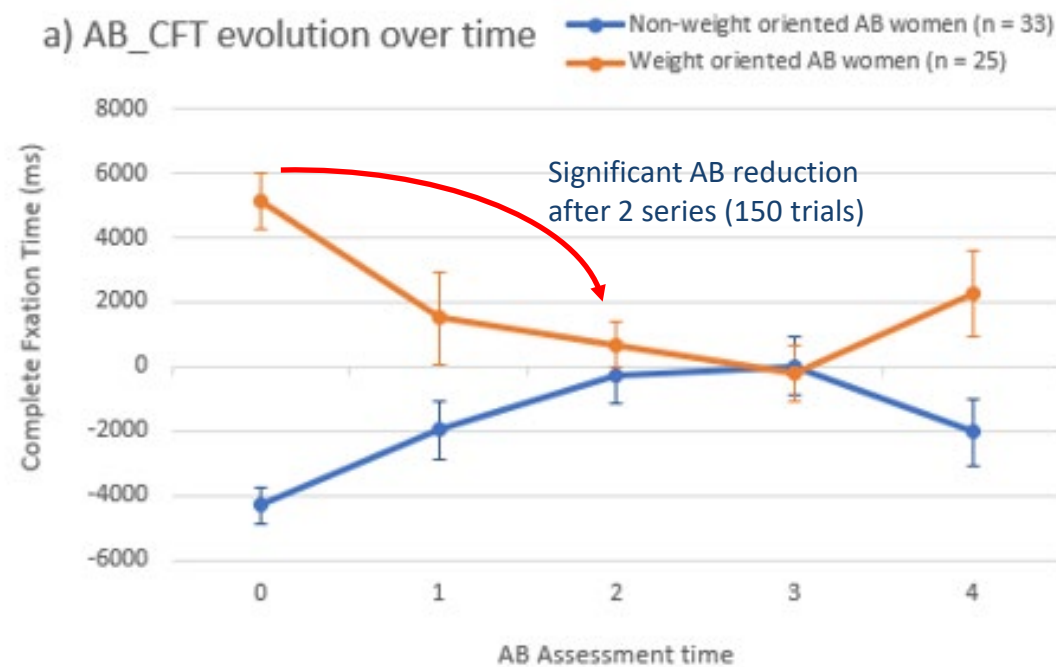
OBJECTIVE: Optimize the Attentional Bias Modification Task duration and the user experience

RESULTS: Pilot study

Participants: 58 college women, divided into two groups depending on baseline AB (non-weight related predominant vs. weight-related Attentional Bias predominant).

Study allowed us to determine that **150 trials (2 series of 75 trials) of figures' projection onto the avatar were sufficient to produce a significant reduction in Attentional Bias measures** (both Complete Fixation Time and Number of Fixations) [10].

Also, we checked that **the user experience** was acceptable.



Attentional Bias (Complete Fixation Time) means evolution over time. AB assessment time: 0 = baseline, 1 = after first ABMT series; 2 = after second ABMT series; 3 = after third ABMT series; 4 = after fourth ABMT series. 75 trials in each ABMT series.

Segund step: case study

OJECTIVE: Increasing the efficacy of MET by incorporating ABMT into MET in the treatment of 4 adolescent females with anorexia nervosa

Will the mirror exposure treatment's efficacy increase by previously reducing the attentional bias?

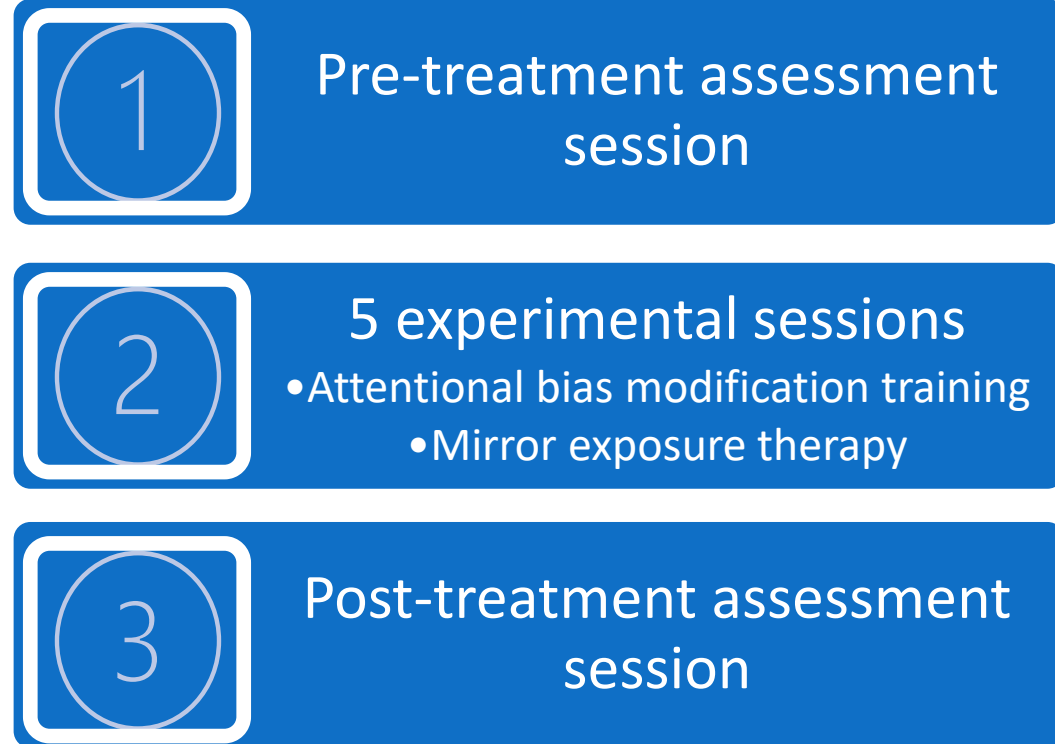
Cases description

4 females

Diagnosis: restrictive anorexia nervosa

	Patient 1	Patient 2	Patient 3	Patient 4
Age	14 y.o .	16 y.o.	17 y.o.	17 y.o.
Comorbidity	Adjustment disorder with anxiety	no	Major depressive disorder and anxiety disorder	Major depressive disorder
Pharmacological treatment	Antidepressants and antipsychotics	no	Antidepressants and occasional anxiolytics	Anxiolytics and antidepressants
Program treatment*	Intensive day-patient treatment (11h)	Day-patient treatment (5h)	Intensive day-patient treatment (11h)	Outpatient program treatment

Procedure



* The treatment consisted of individual and group cognitive-behavioral therapy, nutritional rehabilitation and individual and group parent counseling.



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 enviroment

Full Body Motion Tracking





**In
each
clinical
session**

1

Immersion in the virtual environment

2

Full body ownership illusion

3

Attentional bias modification training

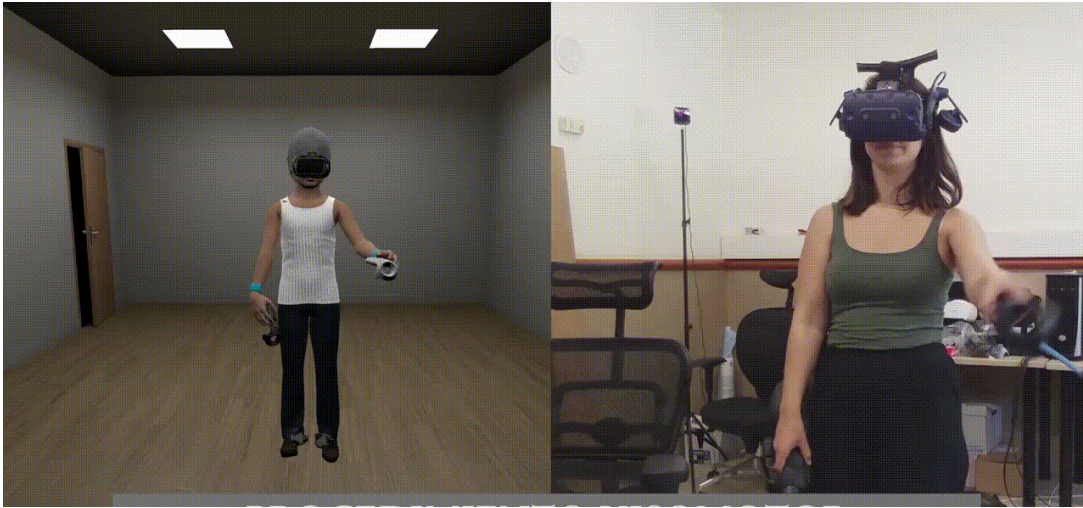
4

Mirror exposure therapy

5

Exposure to a relaxing environment

Full body ownership illusion



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



Attentional bias modification training





**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

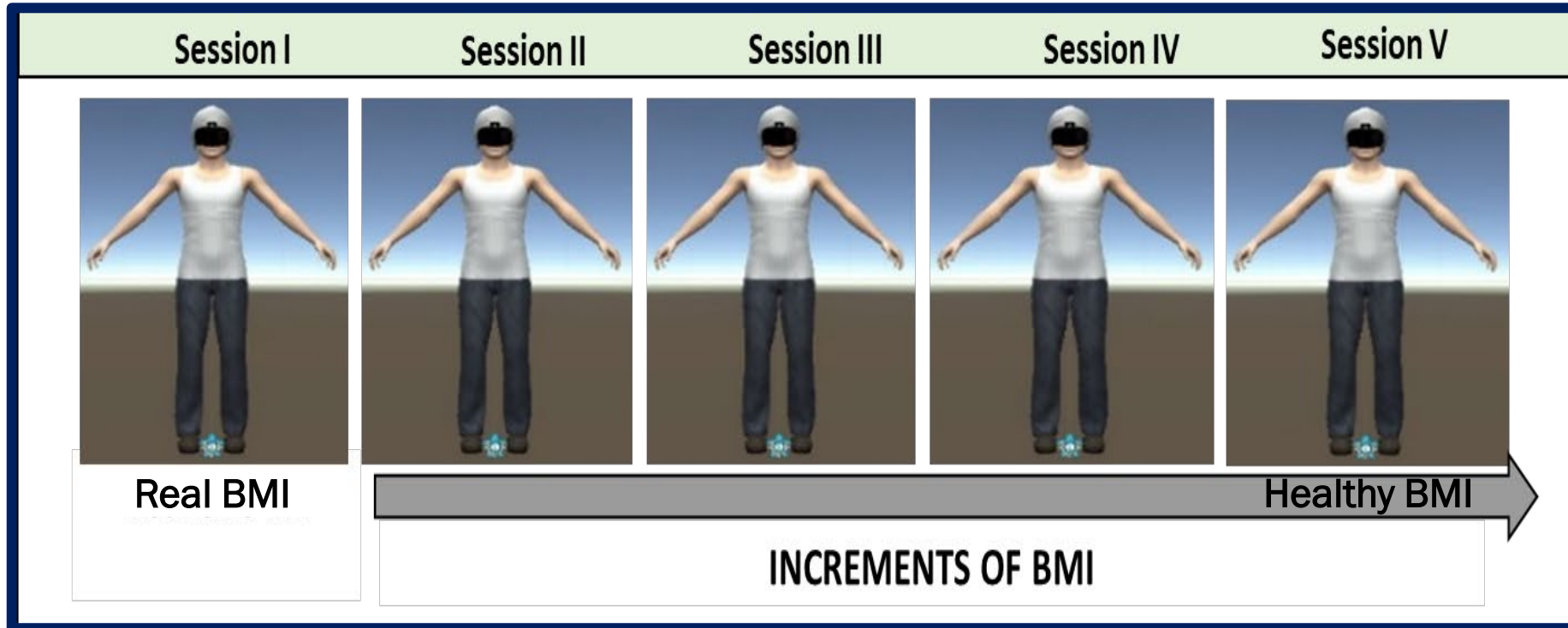
Virtual reality-based Mirror Exposure Therapy



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.

ABMT + MET SESSIONS: BMI HIERARCHY



To progress in the hierarchy, anxiety must decrease by 40% in the previous session

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.



**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

PRE-POST TREATMENT

&

WITHIN-TREATMENT SESSIONS MEASURES

Full Body Ownership Illusion (FBOI)	Visual Analogue Scales (VAS) from 0 to 100
Fear of Gaining Weight	
Anxiety	

PRE-POST TREATMENT MEASURES

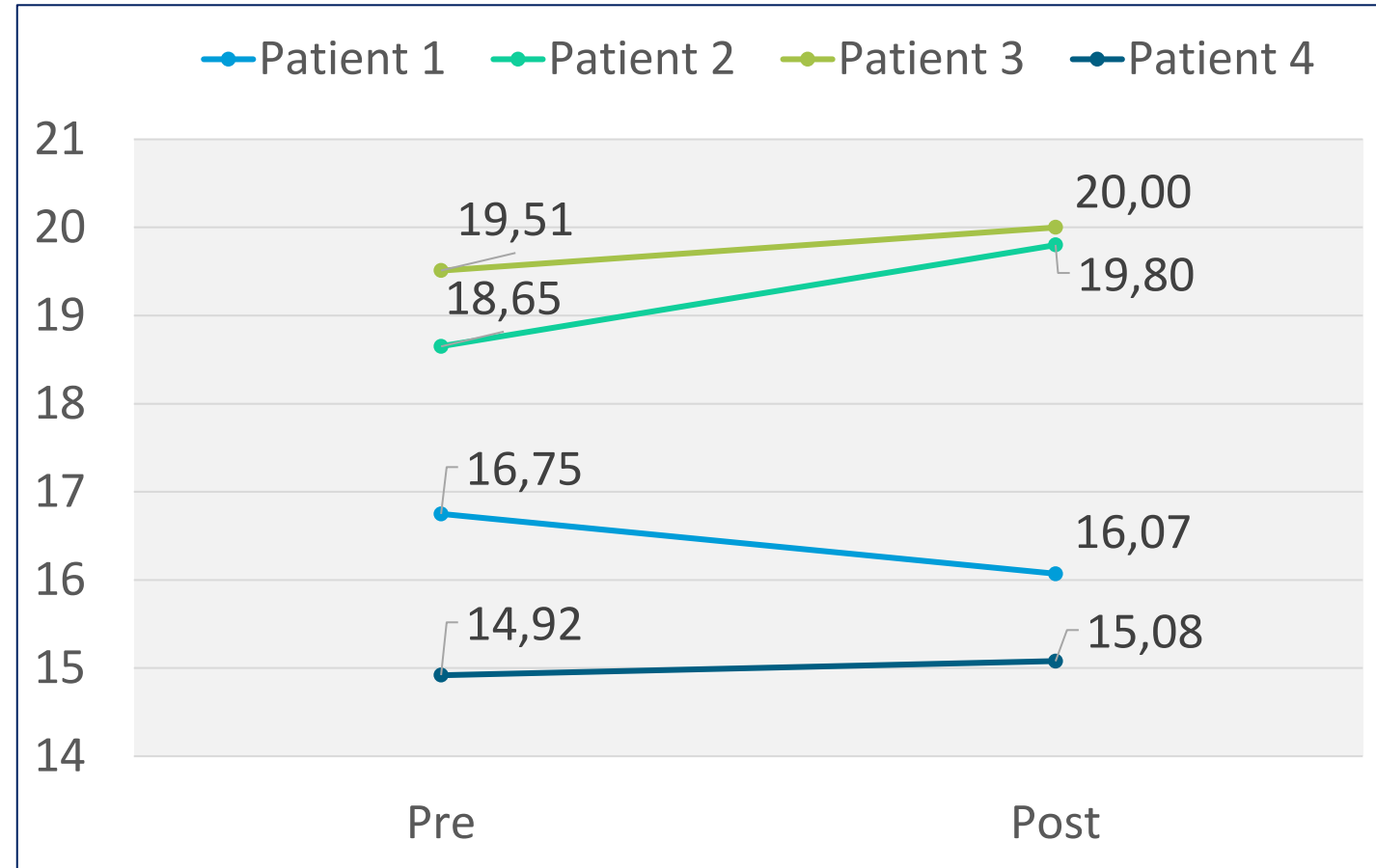


Virtual Reality
Mental Health

Body weight	Body Mass Index (BMI)
Body dissatisfaction	Spanish version of the Body Dissatisfaction subscale of the Eating Disorder Inventory-3 (EDI-BD)
Drive for thinness	Spanish version of the Drive for Thinness subscale of the Eating Disorder Inventory-3 (EDI-DT)
State weight-related body parts anxiety	Physical Appearance State and Trait Anxiety Scale (PASTAS)
Body-checking behaviors	Body Checking Questionnaire (BCQ)
Body appreciation	Body Appreciation Scale (BAS)

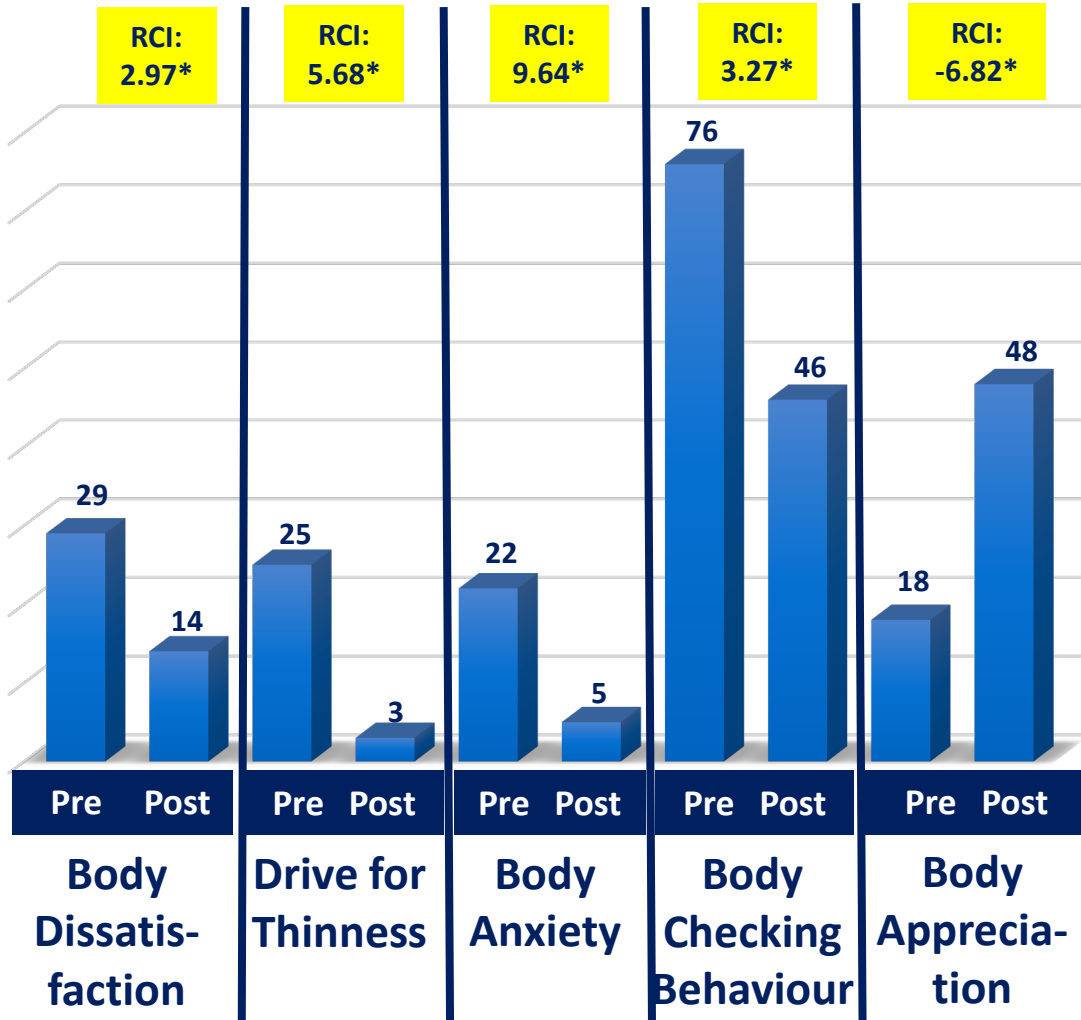
RESULTS: body mass index

BMI increased slightly
at post-treatment assessment
(except for patient 1)
without reaching the minimum
healthy weight.



RESULTS: Patient 1

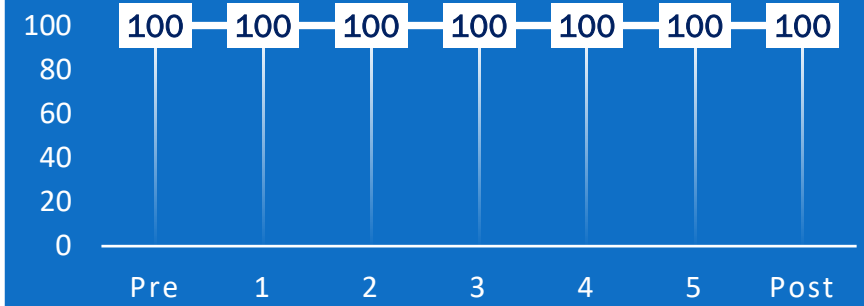
The **RELIABLE CHANGES INDEX (RCI)** for single cases was calculated for the post-assessment measurements only for the measures with clinical and community means and standard deviations.



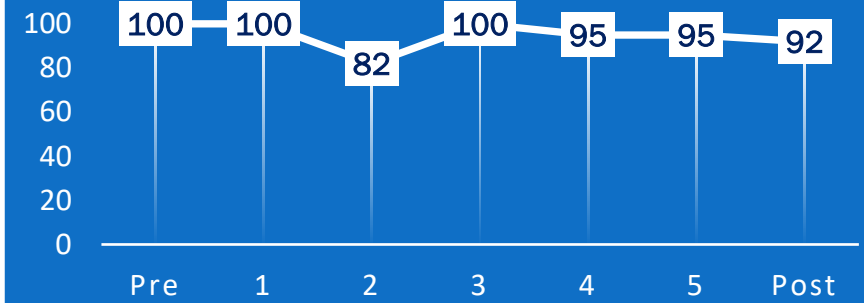
***Significant difference RCI > 1.96**

VISUAL ANALOGUE SCALES

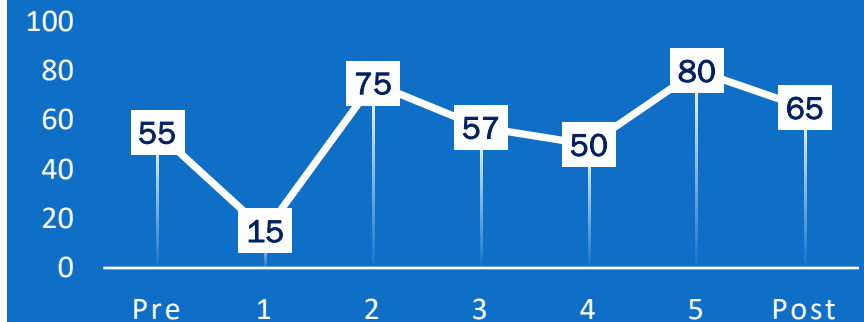
FEAR OF GAINING WEIGHT



ANXIETY

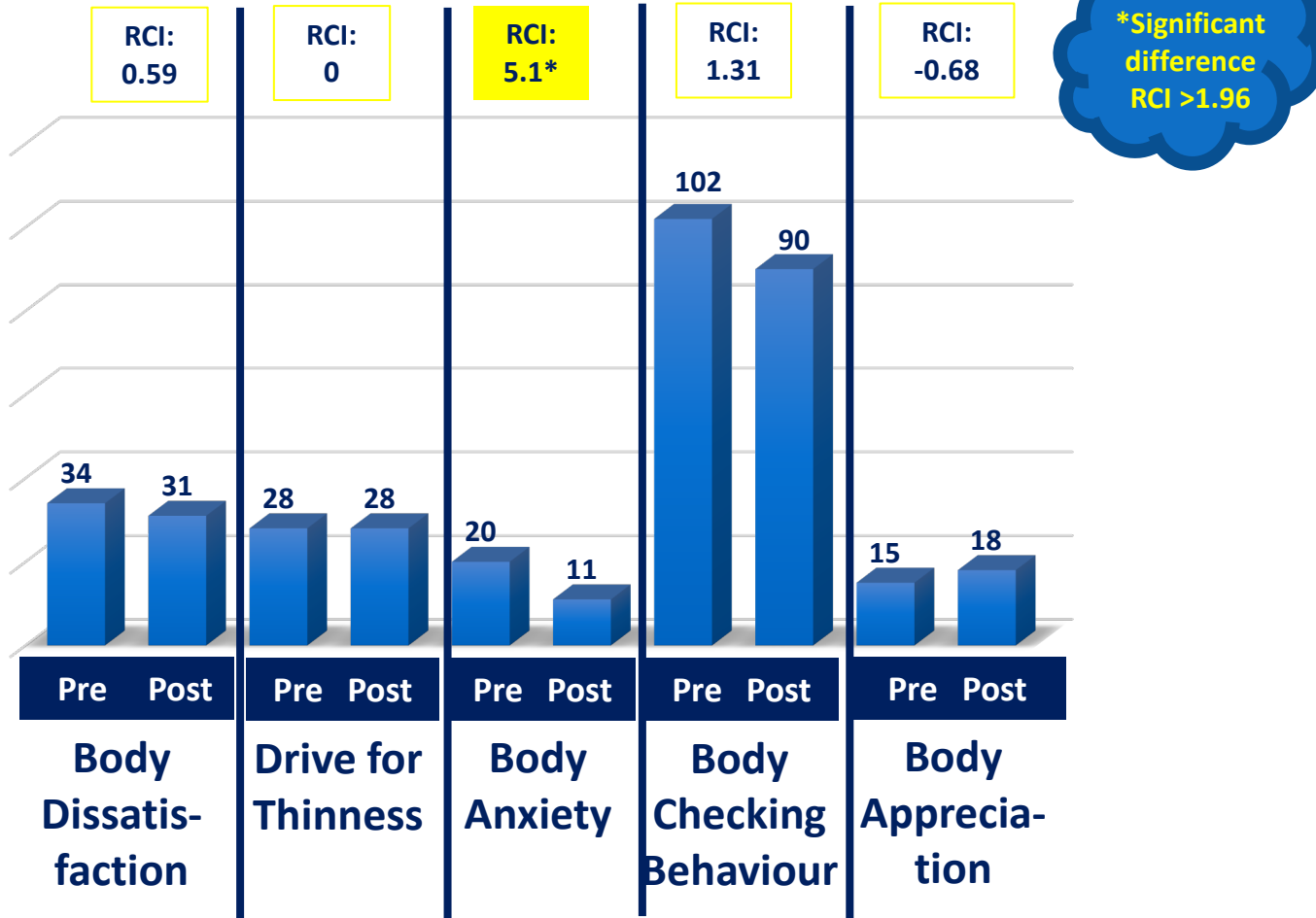


FBOI



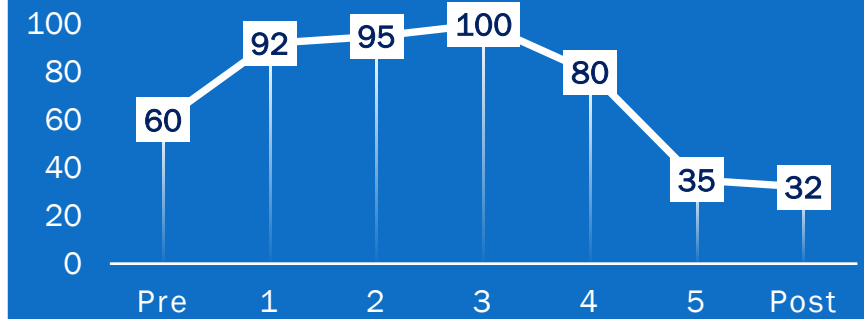
RESULTS: Patient 2

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.

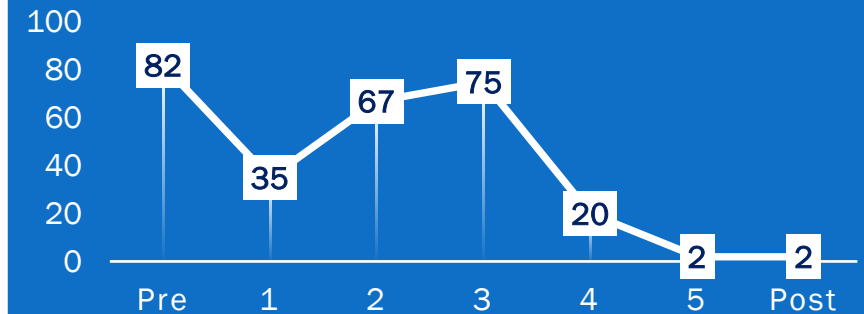


VISUAL ANALOGUE SCALES

FEAR OF GAINING WEIGHT



ANXIETY

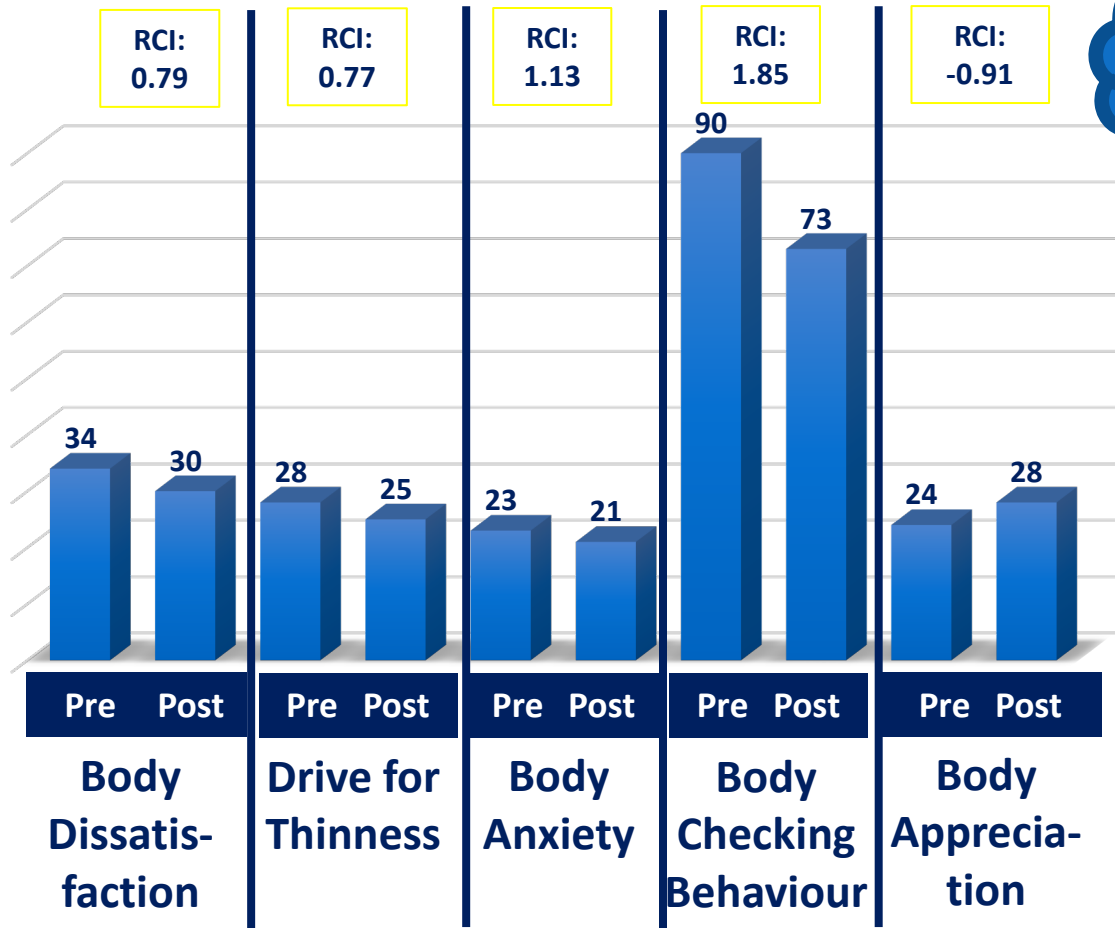


FBOI



RESULTS: Patient 3

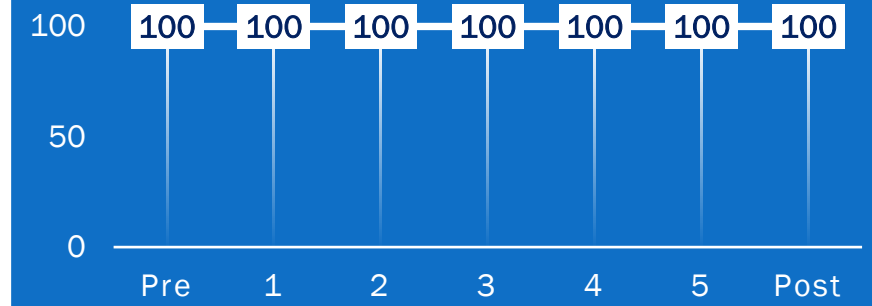
The **RELIABLE CHANGES INDEX (RCI)** for single cases was calculated for the post-assessment measurements only for the measures with clinical and community means and standard deviations.



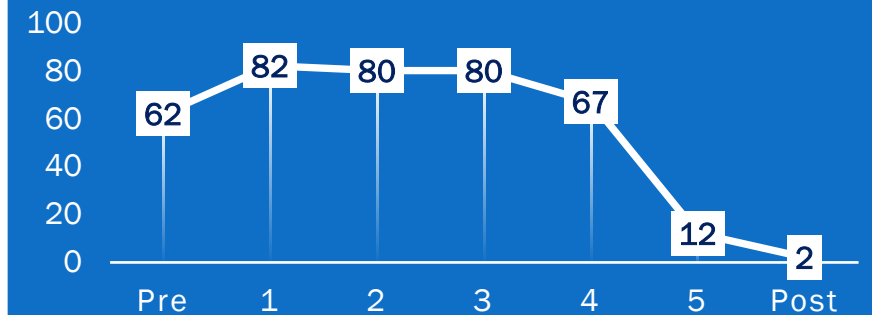
***Significant difference RCI > 1.96**

VISUAL ANALOGUE SCALES

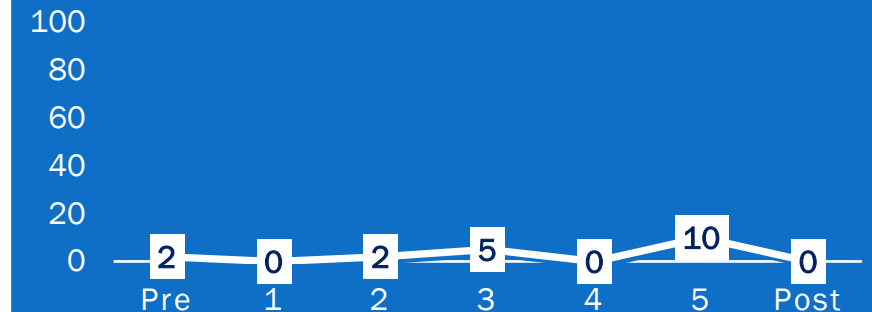
FEAR OF GAINING WEIGHT



ANXIETY

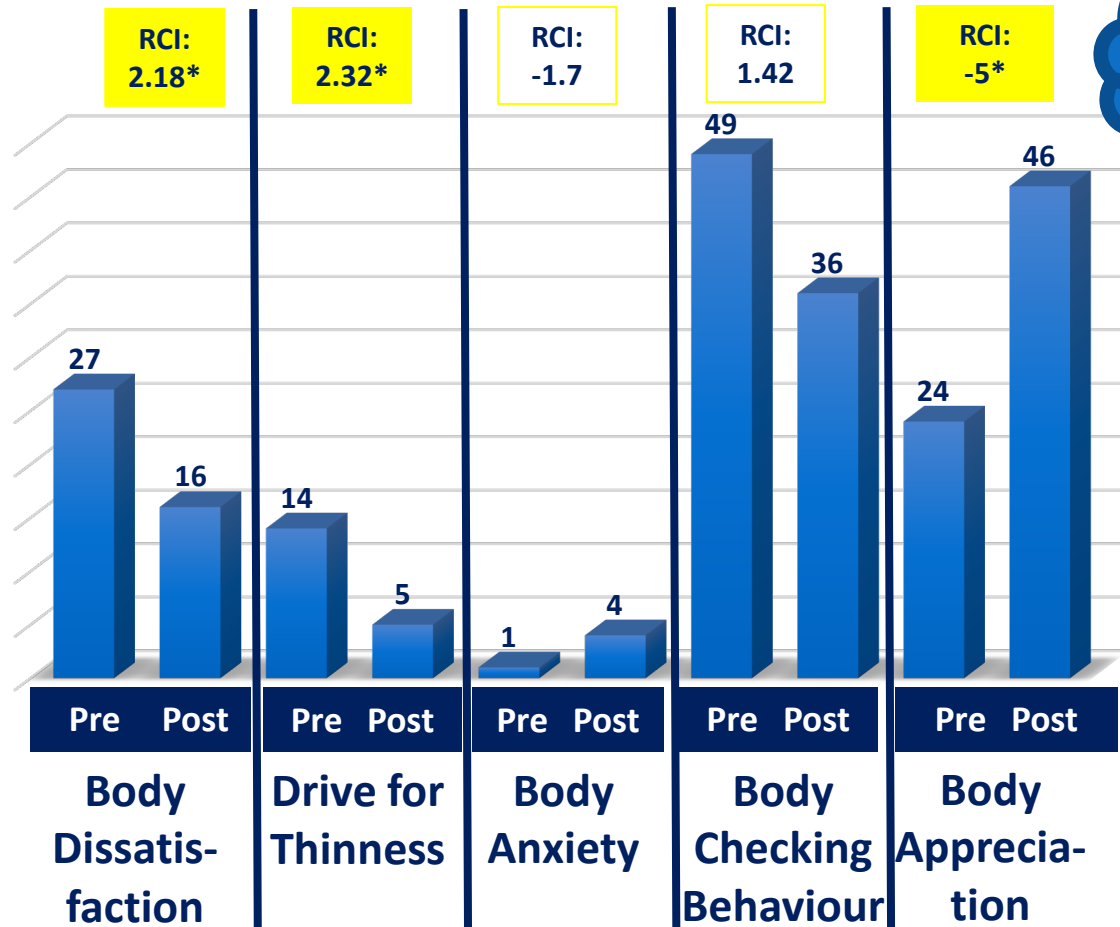


FBOI



RESULTS: Patient 4

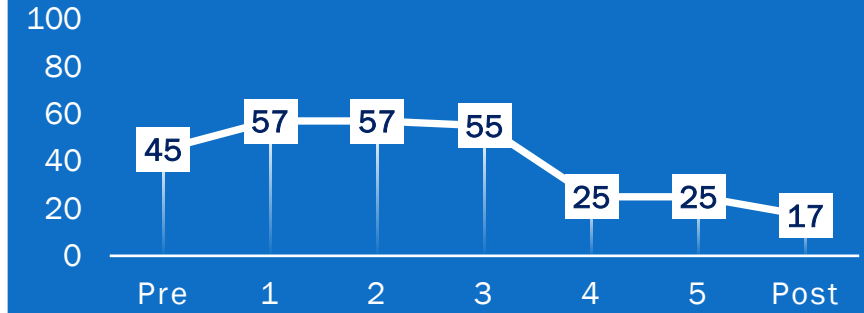
The **RELIABLE CHANGES INDEX (RCI)** for single cases was calculated for the post-assessment measurements only for the measures with clinical and community means and standard deviations.



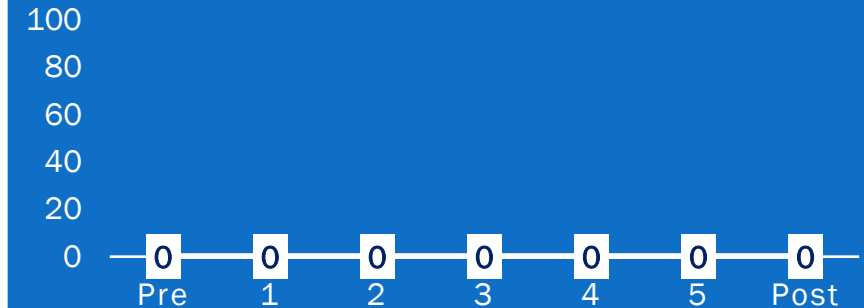
***Significant difference RCI > 1.96**

VISUAL ANALOGUE SCALES

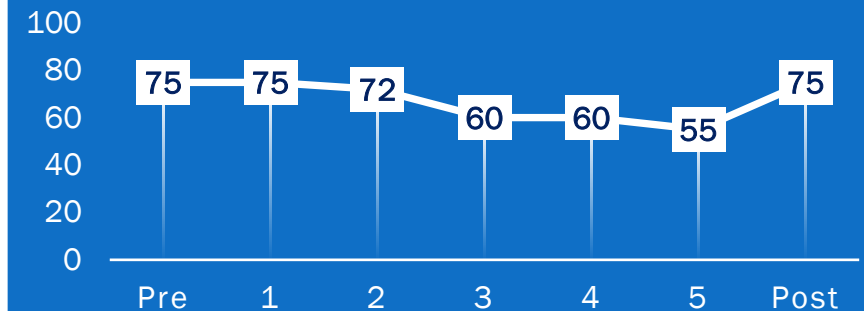
FEAR OF GAINING WEIGHT



ANXIETY



FBOI





Discussion

Patients 1

***The treatment
has been effective***

1. High level of anxiety → Anxiety disorder
2. No reduction in fear of gaining weight

3. High level of full body ownership illusion and identification with the avatar

Patient 3

***Lack of effect
of the treatment***

3. Absence of full body ownership illusion and no identification with the avatar

Final step: Clinical Study

OBJECTIVE: Increasing the efficacy of MET by incorporating ABMT into MET in controlled randomized clinical study

Will the mirror exposure treatment's efficacy increase by previously reducing the attentional bias?

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

Conclusions

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.

VR and ET technologies 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.

Virtual Reality in Mental Health

November 9 & 10, 2023
University Medical Center, Groningen

New Horizons



VRMentalHealth.nl/en/conference

Thank you!

Questions?

Contacts

Franck-Alexandre Meschberger-Annweiler: franck.meschberger@ub.edu

José Gutiérrez-Maldonado: jgutierrezm@ub.edu



UNIVERSITAT DE
BARCELONA

SJD Sant Joan de Déu
Barcelona · Hospital



Institut de Neurociències
UNIVERSITAT DE BARCELONA