



***Eye-tracking and virtual reality-based attentional bias modification training to improve mirror exposure therapy: preliminary findings from a multiple case study with anorexia nervosa patients***

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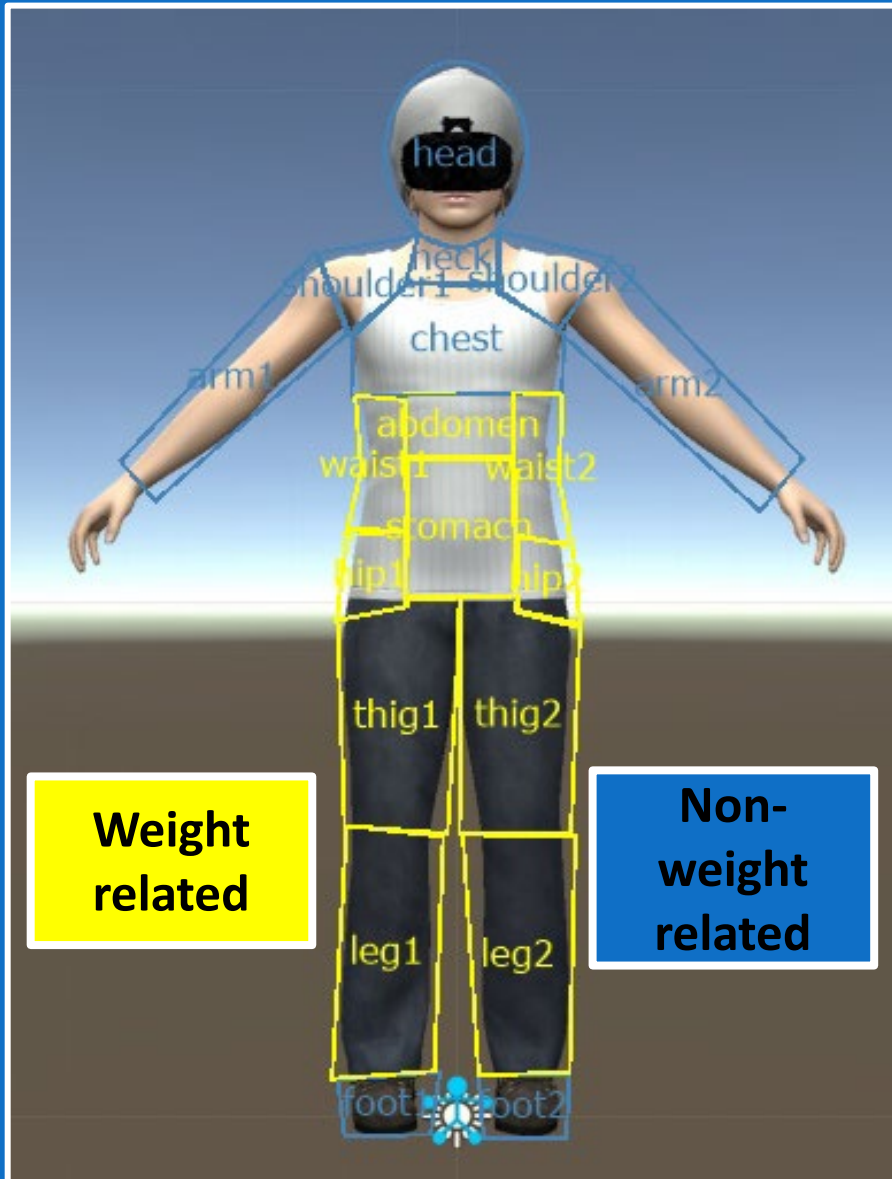
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*The authors declare that they have no conflict of interest.*

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



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

## ***Body-related attentional bias***



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)*

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

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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

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**

## Study purpose

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

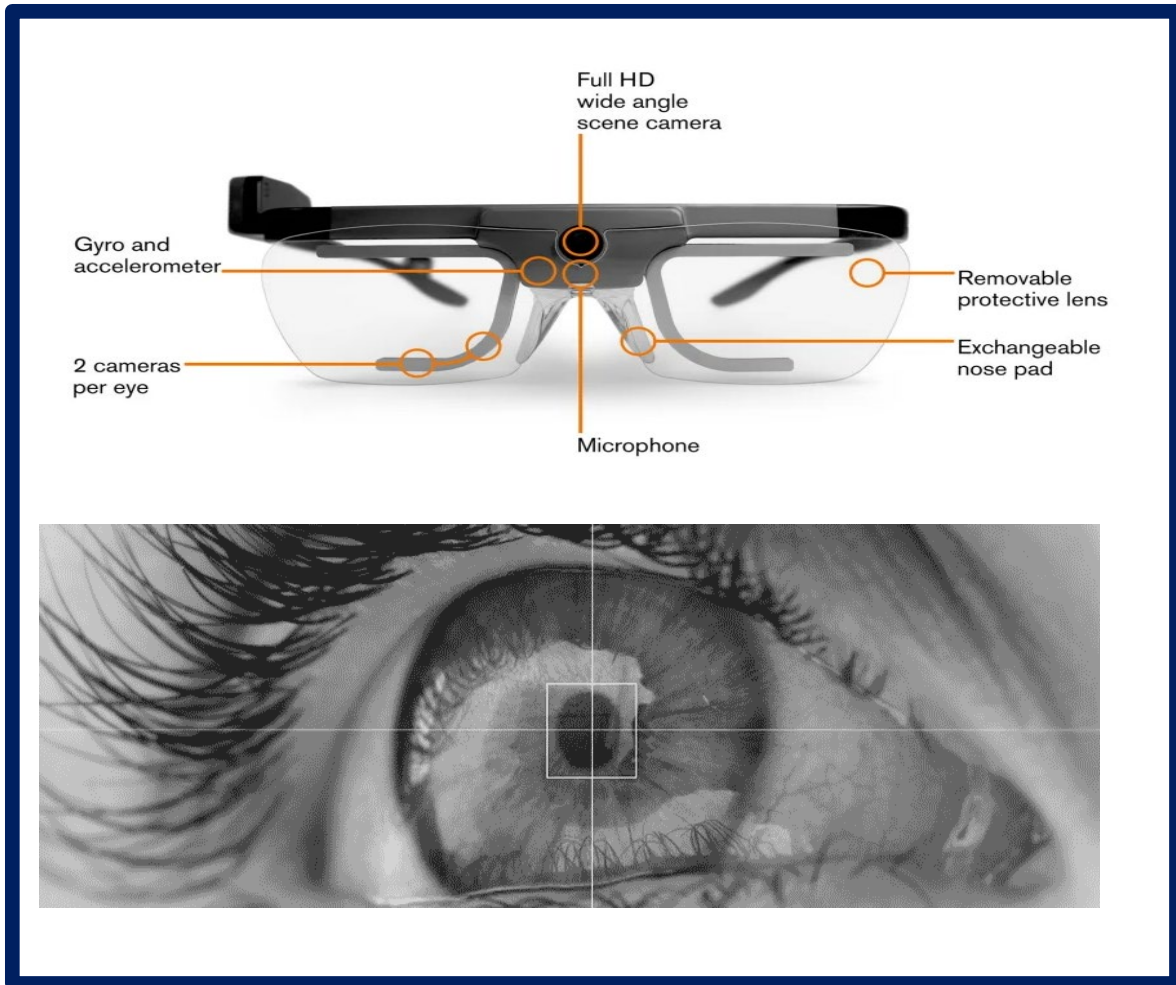
Will the mirror exposure treatment's efficacy increase by previously reducing the attentional bias?

# Attentional Bias Modification Training & Mirror Exposure Therapy

Eye-tracking

+

Virtual reality



# Methodology

## Cases description

4 females

**Diagnosis: restrictive anorexia nervosa**

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

## Procedure



Pre-treatment assessment session



5 experimental sessions

- Attentional bias modification training
- Mirror exposure therapy

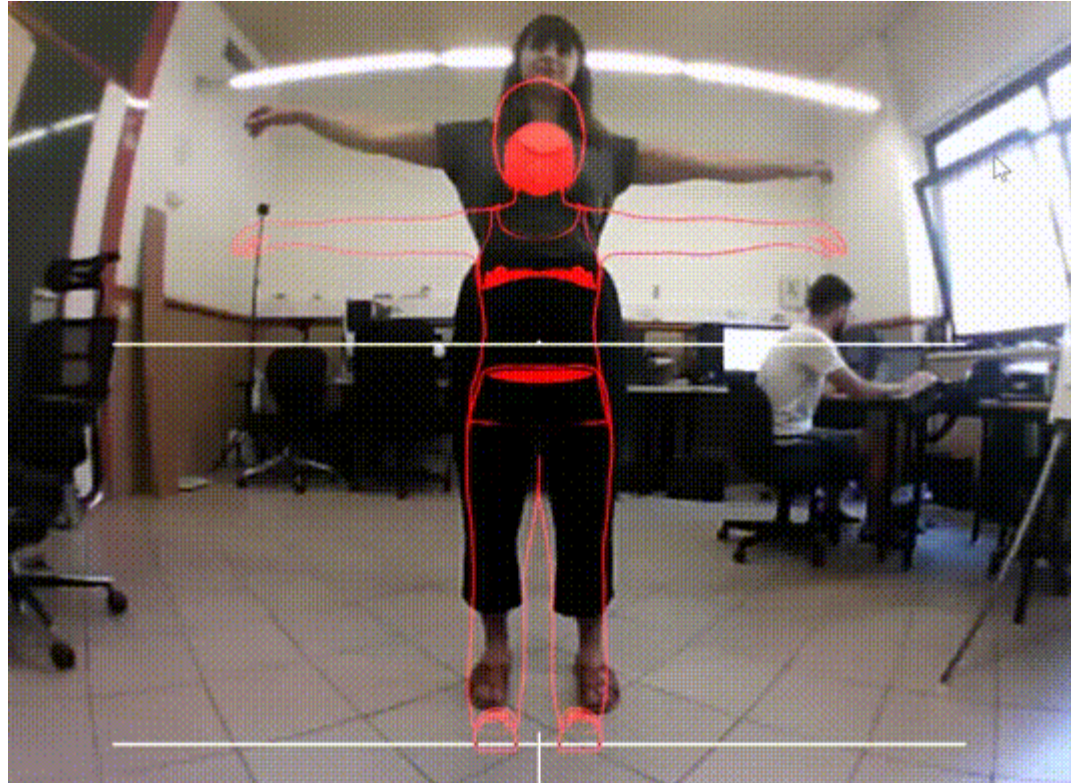


Post-treatment assessment session

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



# Creating a personalised avatar



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 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

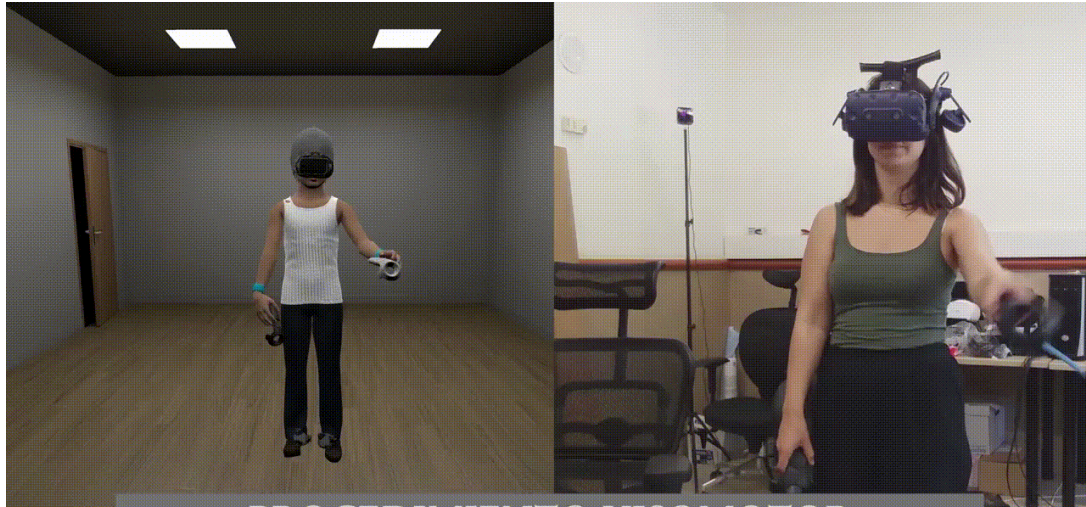
4

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.*

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Attentional bias modification training

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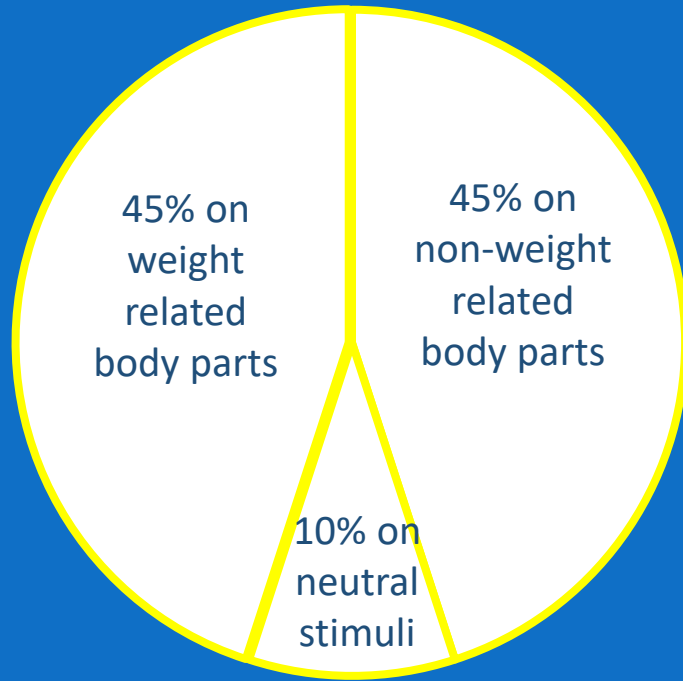
Mirror exposure therapy

5

Exposure to a relaxing environment

# Attentional bias modification training

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

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.



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Exposure to a relaxing environment



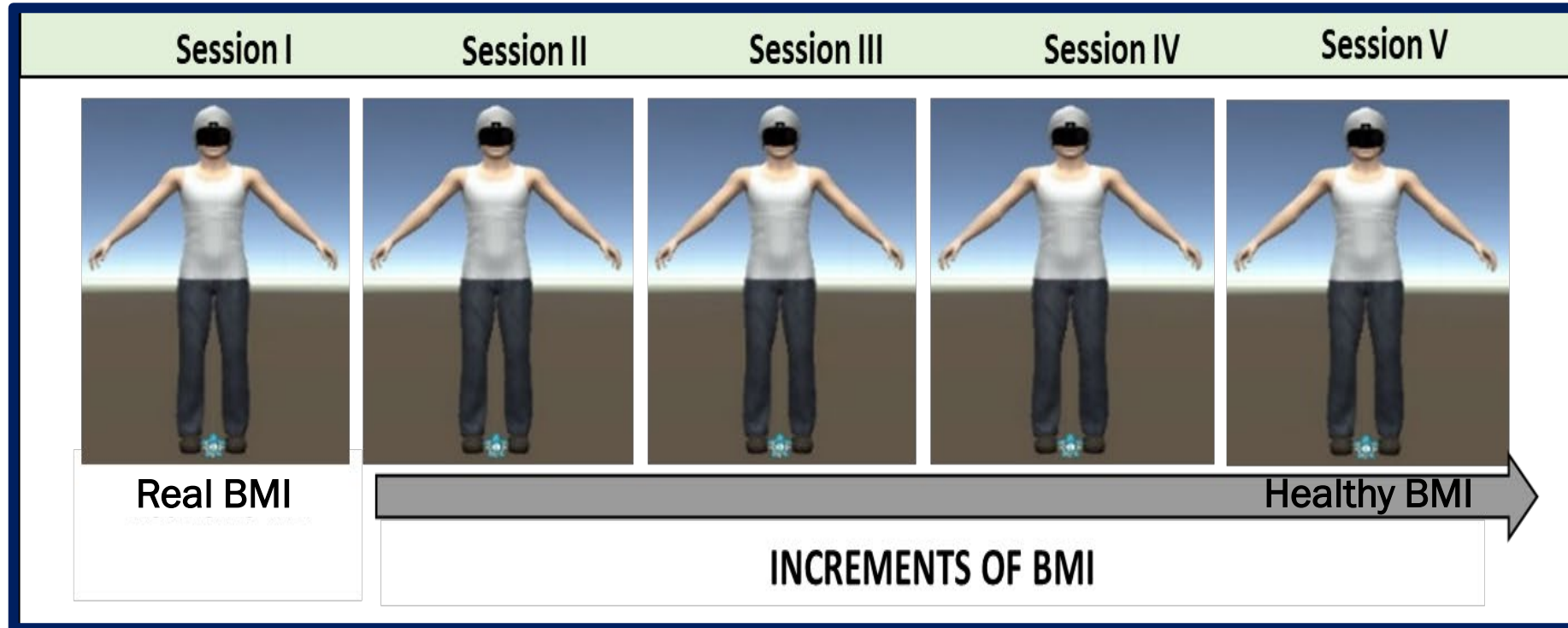
## Virtual reality-based Mirror Exposure Therapy



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



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.

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# PRE-POST TREATMENT & WITHIN-TREATMENT SESSIONS MEASURES

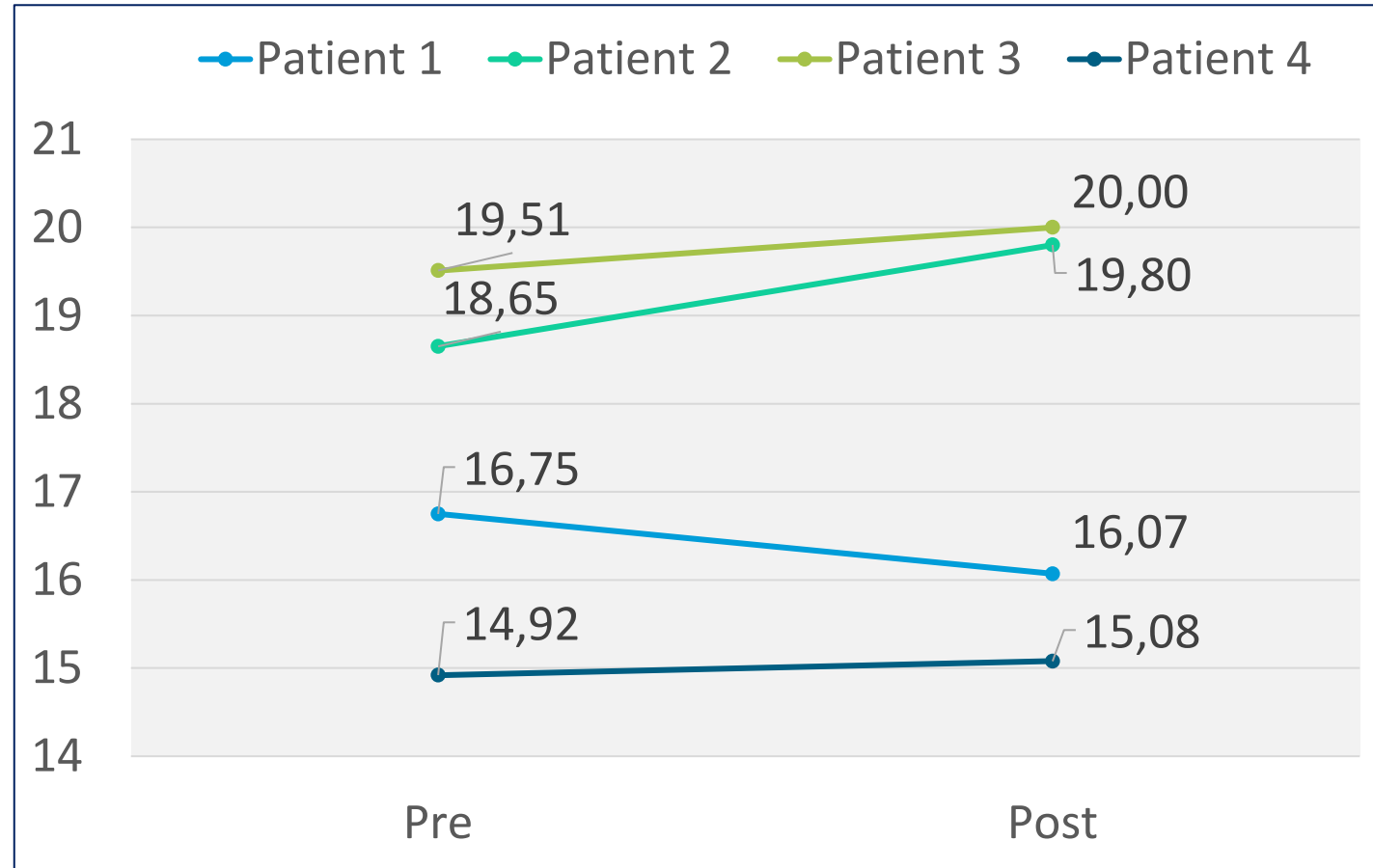
<b>Full Body Ownership Illusion (FBOI)</b>	Visual Analogue Scales (VAS) from 0 to 100
<b>Fear of Gaining Weight</b>	
<b>Anxiety</b>	

# PRE-POST TREATMENT MEASURES

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

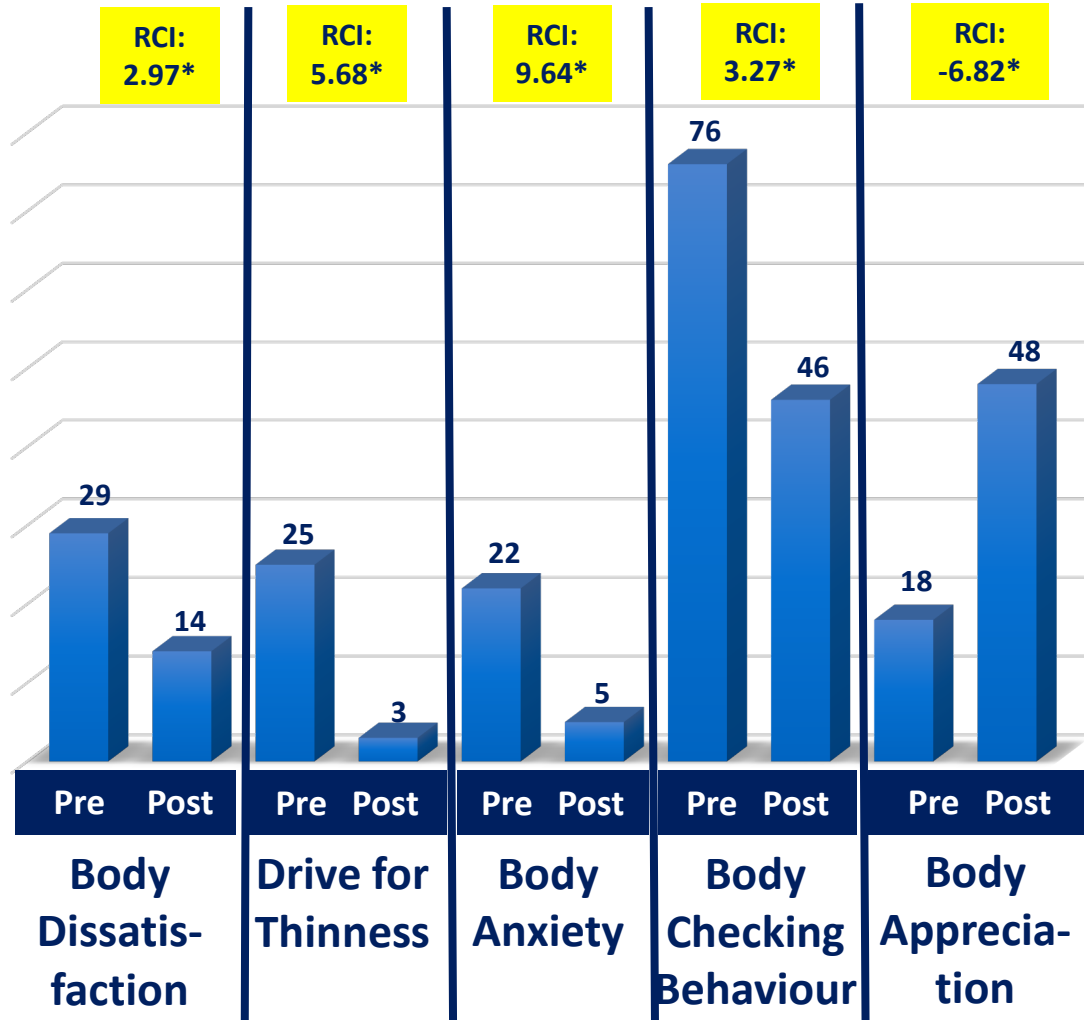
# RESULTS: body mass index

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



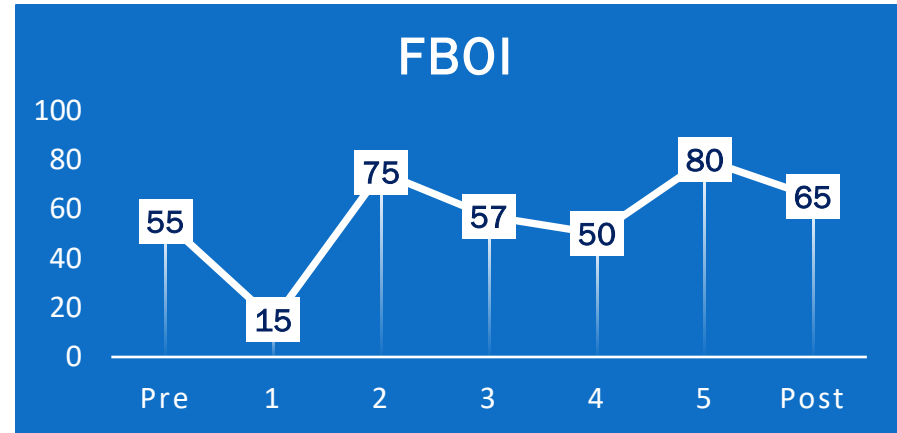
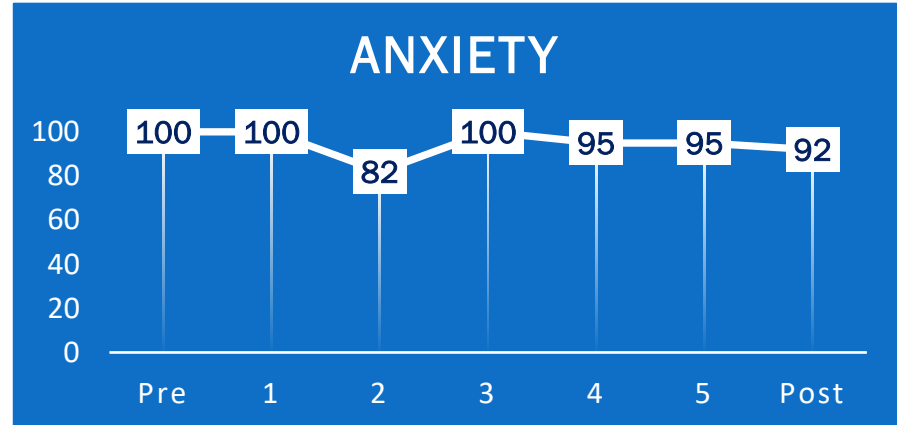
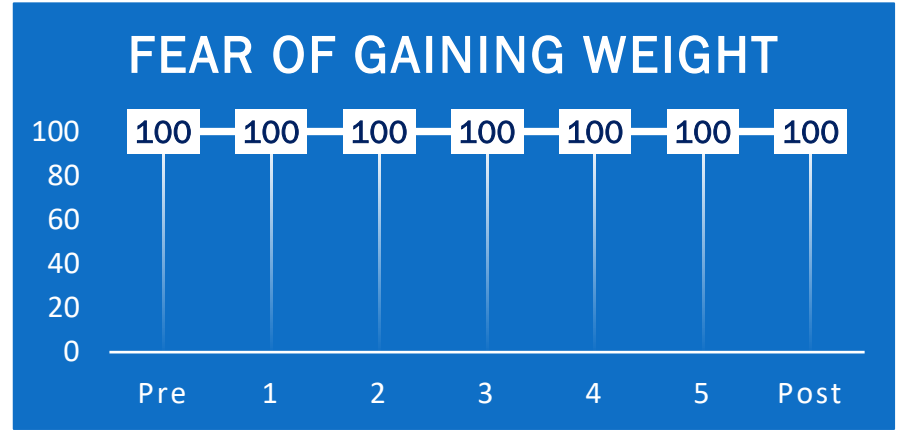
# RESULTS: Patient 1

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.



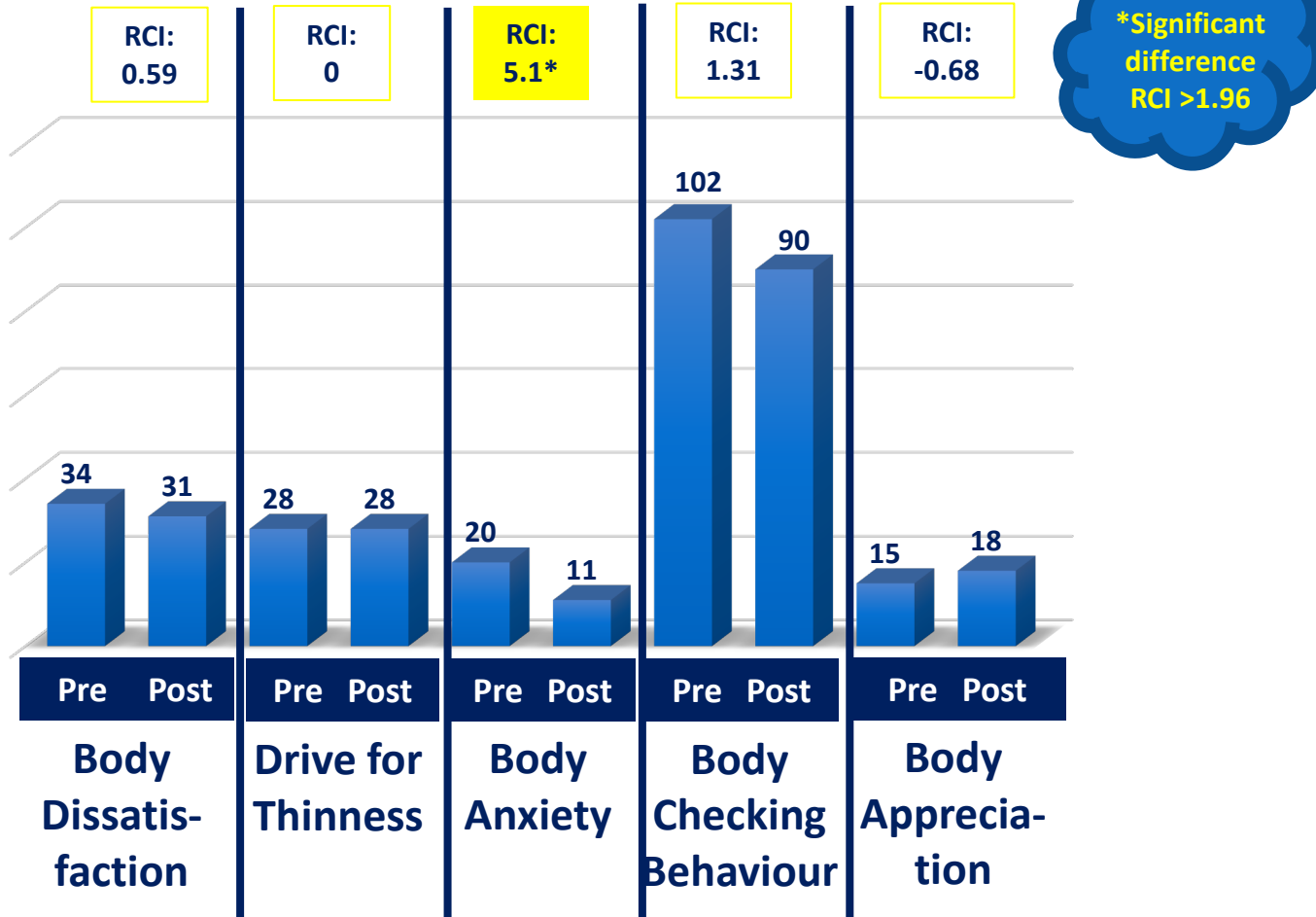
**\*Significant difference RCI > 1.96**

## VISUAL ANALOGUE SCALES



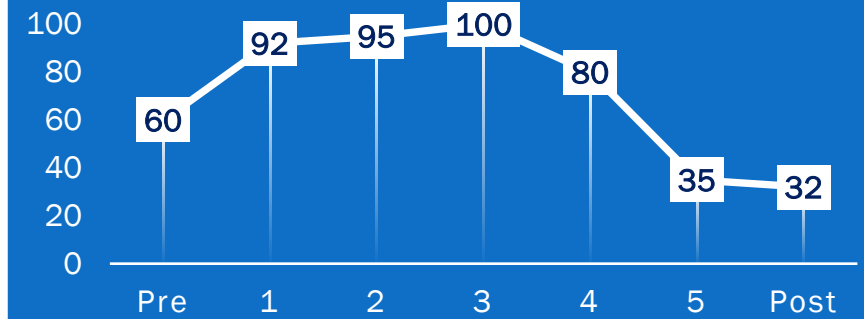
# RESULTS: Patient 2

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.

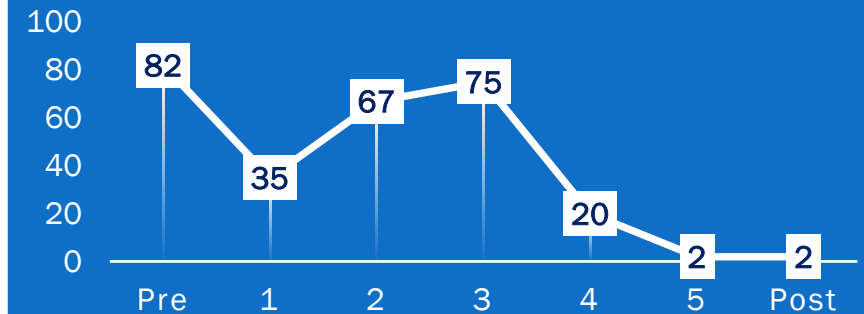


## VISUAL ANALOGUE SCALES

### FEAR OF GAINING WEIGHT



### ANXIETY

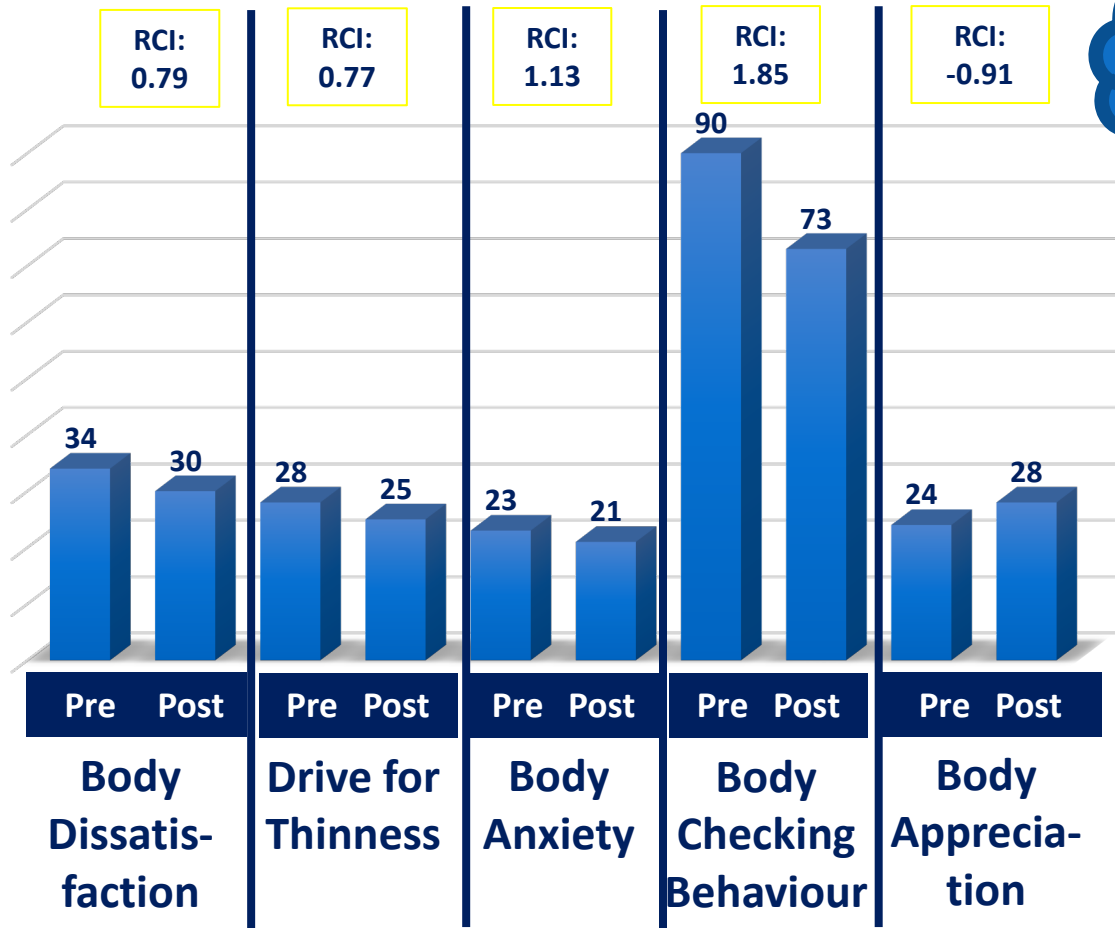


### FBOI



# RESULTS: Patient 3

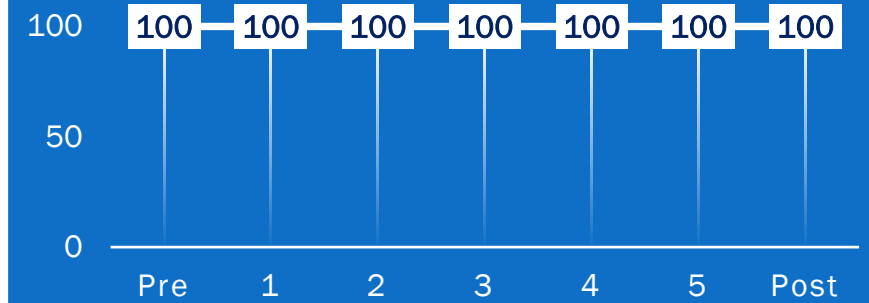
The **RELIABLE CHANGES INDEX (RCI)** for single cases was calculated for the post-assessment measurements only for the measures with clinical and community means and standard deviations.



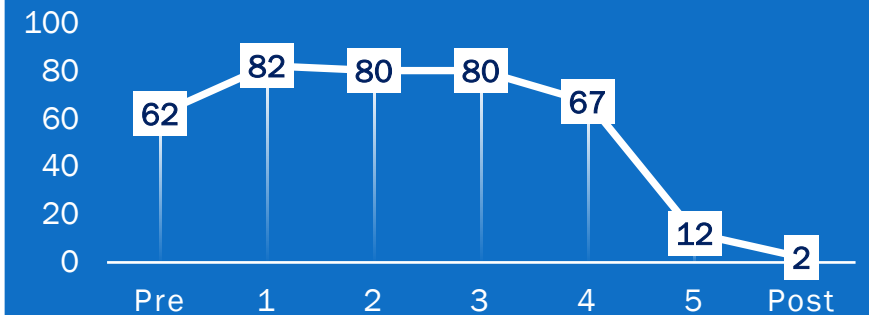
**\*Significant difference RCI > 1.96**

## VISUAL ANALOGUE SCALES

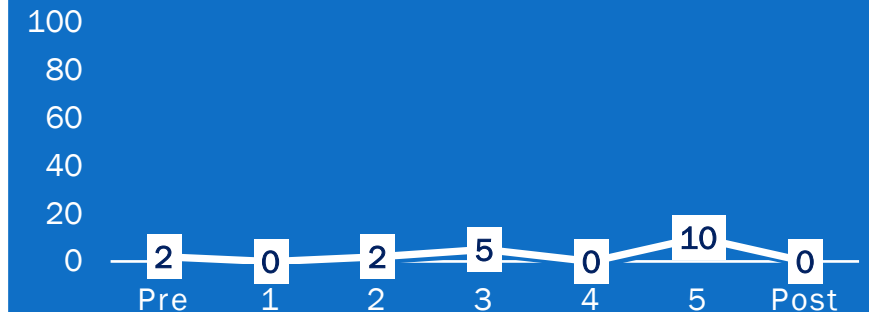
### FEAR OF GAINING WEIGHT



### ANXIETY



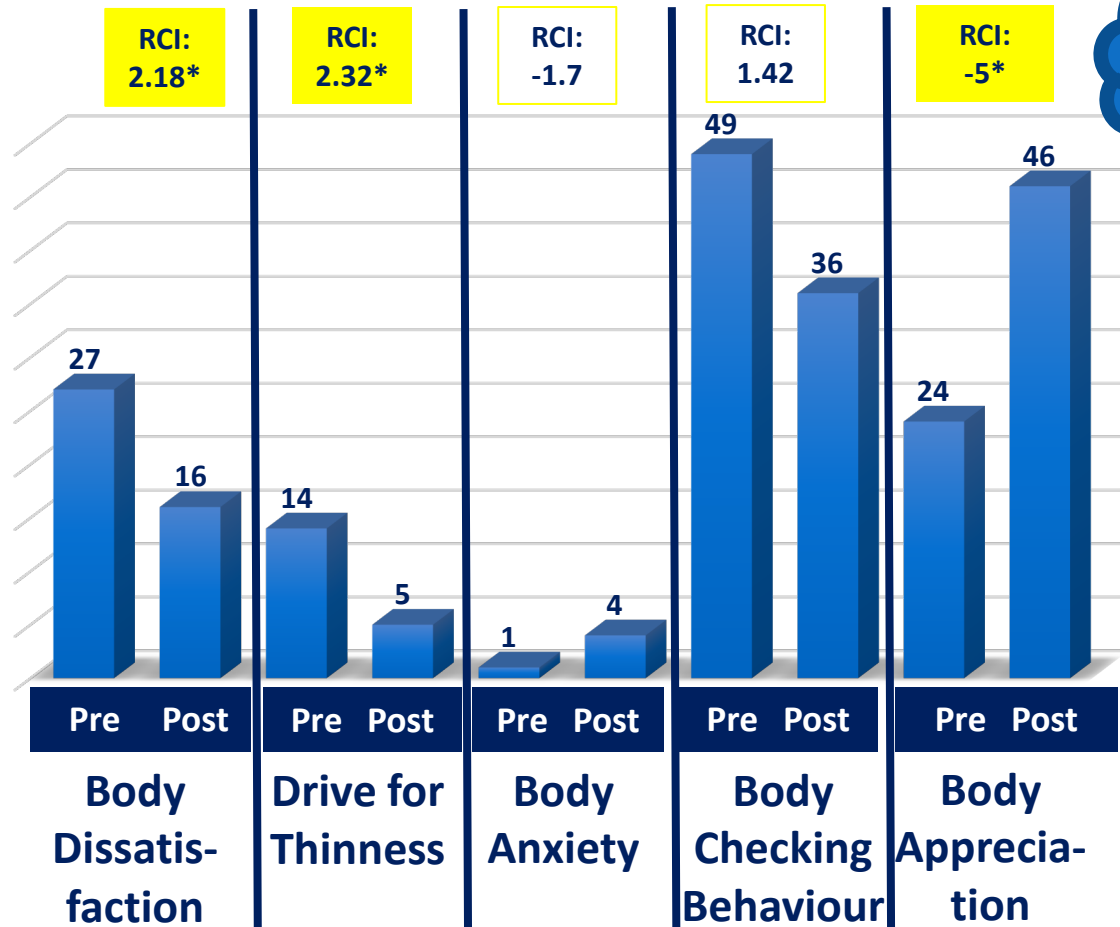
### FBOI





# RESULTS: Patient 4

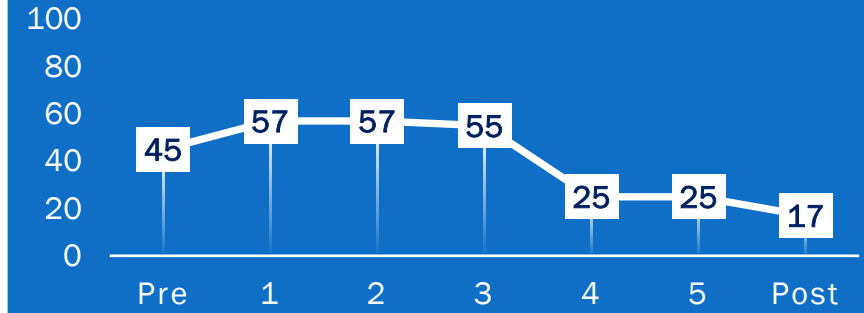
The **RELIABLE CHANGES INDEX (RCI)** for single cases was calculated for the post-assessment measurements only for the measures with clinical and community means and standard deviations.



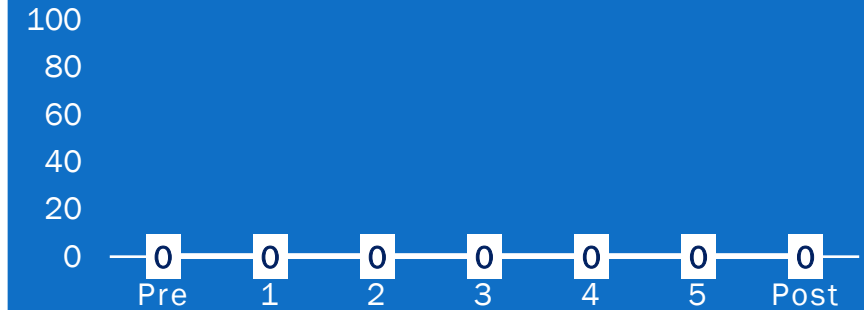
**\*Significant difference RCI > 1.96**

## VISUAL ANALOGUE SCALES

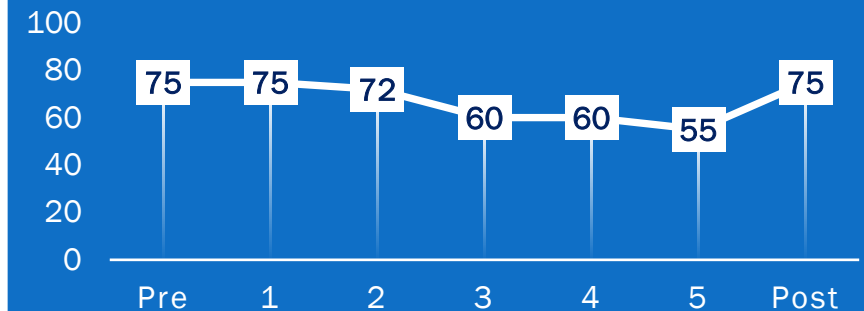
### FEAR OF GAINING WEIGHT



### 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

# Innovations

**Incorporate a  
pioneering  
ABMT into MET**

**Take advantage of  
virtual reality and  
eye-tracking  
technologies**

# Future research

*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.



*Thank you!*

***Questions?***

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