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# *Attentional bias modification, through Virtual Reality-based body exposure, to enhance efficacy of treatment of anorexia nervosa (work in progress).*


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# Virtual Reality and Embodied Medicine

## New opportunities for research and treatment of Eating Disorders

Virtual Reality (VR)

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].


[1] Gutiérrez-Maldonado, J.; Wiederhold, B.K.; Riva, G. Future Directions: How Virtual Reality Can Further Improve the Assessment and Treatment of Eating Disorders and Obesity. *Cyberpsychol. Behav. Soc. Netw*. ***2016***, 19, 148–153.

# Virtual Reality and Embodied Medicine

## New opportunities for research and treatment of Eating Disorders

Embodied Medicine

**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.

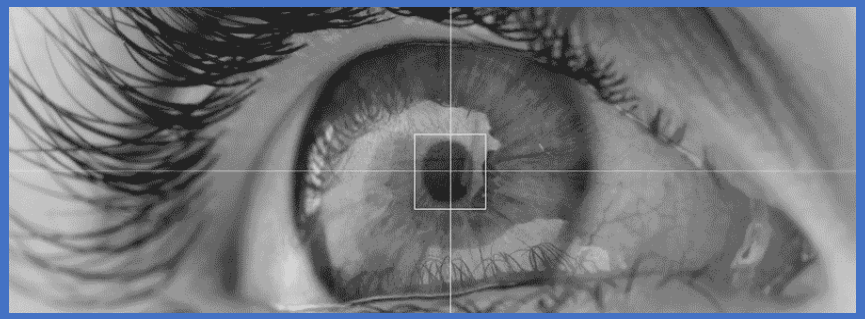
**New transdisciplinary research field**: the “embodied medicine”, aiming to use advanced technologies to alter the experience of being in a body in order to improve the health and wellbeing [2-5].


[2] Riva, G.; Serino, S.; Di Lernia, 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.

# Virtual Reality and Embodied Medicine

## New opportunities for research and treatment of Eating Disorders

### Eye-Tracking (ET)



ET 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.

# Virtual Reality Lab

## A long experience in Mental Health research, combining VR & ET technologies.

### Craving to smoke

Validation of smoking-related virtual environments for cue exposure therapy [8].

### Alcohol craving

**ALCO-VR**:
Cue-Elicited Anxiety and Alcohol Craving [9,10].

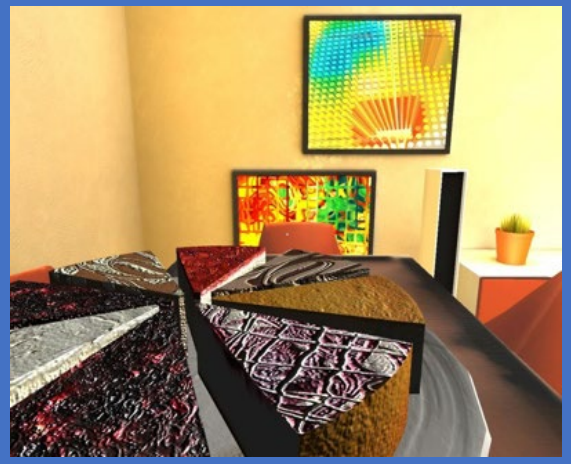

[8] García-Rodríguez,O; Pericot-Valverde, I.; Gutiérrez-Maldonado, J.; Ferrer-García, M.; Secades-Villa, R. Validation of smoking-related virtual environments for cue exposure therapy, *Addictive Behaviors,* ***2012***, 37 (6), 703-708.
[9] Ghiţă, A.; Hernández-Serrano, O.; Fernández-Ruiz, Y.; Monras, M.; Ortega, L.; Mondon, S.; Teixidor, L.; Gual, A.; Porras-García, B.; Ferrer-García, M.; Gutiérrez-Maldonado, J. Cue-Elicited Anxiety and Alcohol Craving as Indicators of the Validity of ALCO-VR Software: A Virtual Reality Study. *J. Clin. Med.* ***2019***, 8, 1153.
[10] Ghiţă, A.et alt. Attentional Bias Assessment in Patients with Alcohol Use Disorder: an eye-tracking study. *Annual Review of CyberTherapy and Telemedicine,* ***2019***, 17.

# Virtual Reality Lab

## A long experience in Mental Health research, combining VR & ET technologies.

Eating Disorders (ED)

**VR-CET**:
Cue-exposure software for the treatment of bulimia nervosa and binge eating disorder [11].



**BIAS**:
VR-based Body Image Assessment Software [12]


[11] Gutierrez-Maldonado, J., Pla-Sanjuanelo, J., Ferrer-Garcia, M. Cue-exposure software for the treatment of bulimia nervosa and binge eating disorder. *Psicothema, **2016***, 28(4), 363-369.
[12] Ferrer-García, M., Gutiérrez-Maldonado, J. Body Image Assessment Software: Psychometric data. *Behavior Research Methods, **2008***, 40, 394–407.

*Work in progress: our current project*

# VR-based Attentional Bias Modification to enhance efficacy of treatment of Anorexia Nervosa.

VR technology allows us to:

- Create realistic mirror exposure setting (ecologically valid).
- Create realistic avatars (fitting participants' real silhouettes)
- Enhance full body ownership illusion (FBI) through visuomotor and visuo-tactile stimulations.
- Modify Avatar's Body Mass Index (BMI) progressively.
- Implement Attentional Bias Modification Task (ABMT).

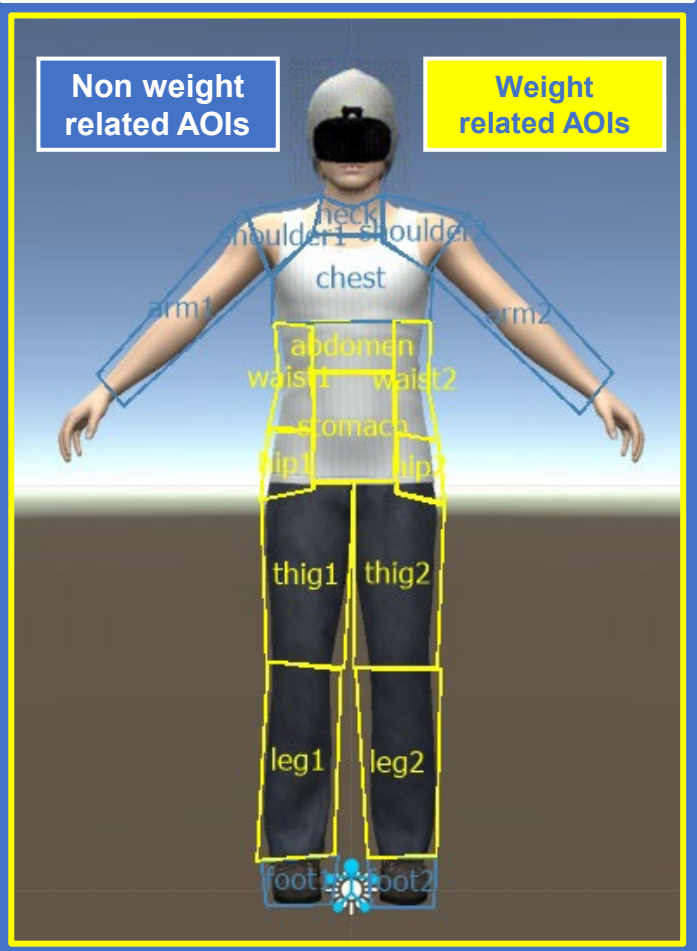
*Work in progress: our current project*

# VR-based Attentional Bias Modification to enhance efficacy of treatment of Anorexia Nervosa.

## First VR-based Attentional Bias Modification Task

- Adapted to VR from Smeets et alt. (2011) [13].
- Projection of geometric figures in a balanced way between weight and non-weight related body areas (defined from PASTAS questionnaire) [14].

**Areas Of Interest***





[13] 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

[14] 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.

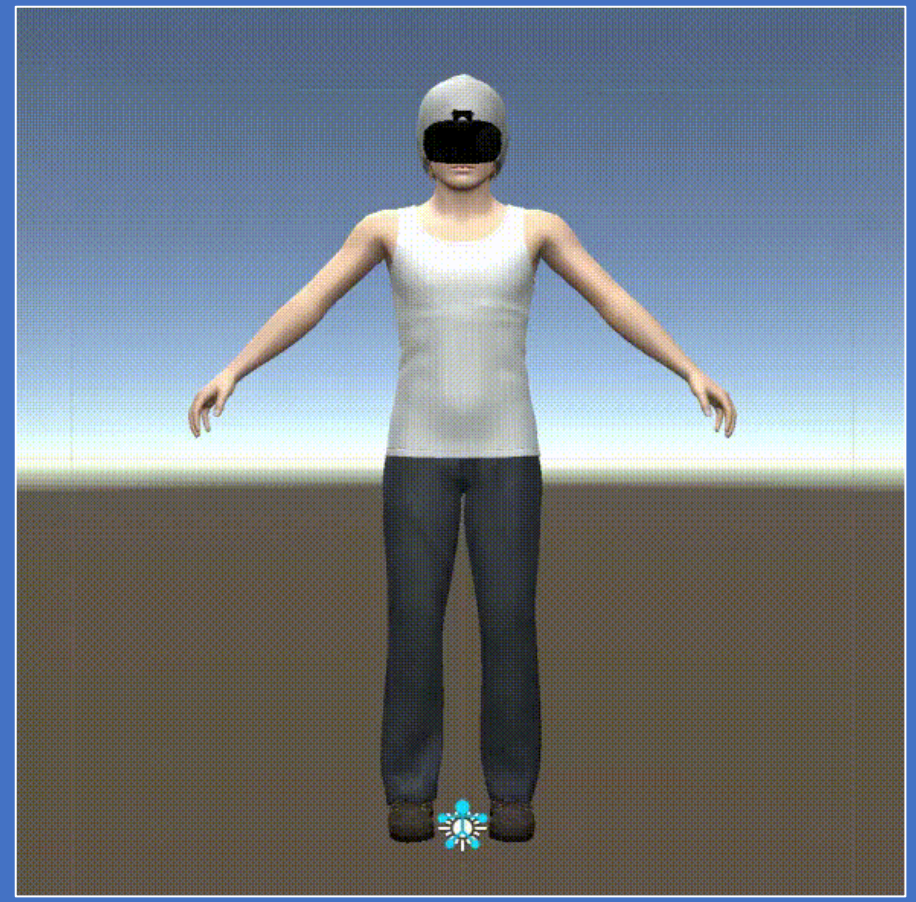
*Work in progress: our current project*

# VR-based Attentional Bias Modification to enhance efficacy of treatment of Anorexia Nervosa.

ET technology allows us to:

- Assess Attentional Bias (AB) continuously and objectively (2 constructs: Complete Fixation Time -CFT- and Number of fixations -NF-) before and after the intervention.

- Process ET data with Open Gaze and Mouse Analyzer software “OGAMA” (Freie Universität, Berlin, Germany).



# *Work in progress: our current project*

# VR-based Attentional Bias Modification to enhance efficacy of treatment of Anorexia Nervosa.

## Main objectives:

Reduce:

- Body-related Attentional Bias (AB).
- Body Image Disturbances (BIDs), including Body Dissatisfaction (BD), and Fear of Gaining Weight (FGW), as main risk and maintenance factors of Anorexia Nervosa (AN) [15].

[15] Linardon, J.; Phillipou, A.; Castle, D.; Newton, R.; Harrison, P.; Cistullo, L.L.; Griffiths, S.; Hindle, A.; Brennan, L. The relative associations of shape and weight over-evaluation, preoccupation, dissatisfaction, and fear of weight gain with measures of psychopathology: An extension study in individuals with anorexia nervosa. *Eat. Behav.* ***2018***, 29, 54–58.

# What has already been achieved:

## *1. The influence of gender on body-related Attentional Bias*

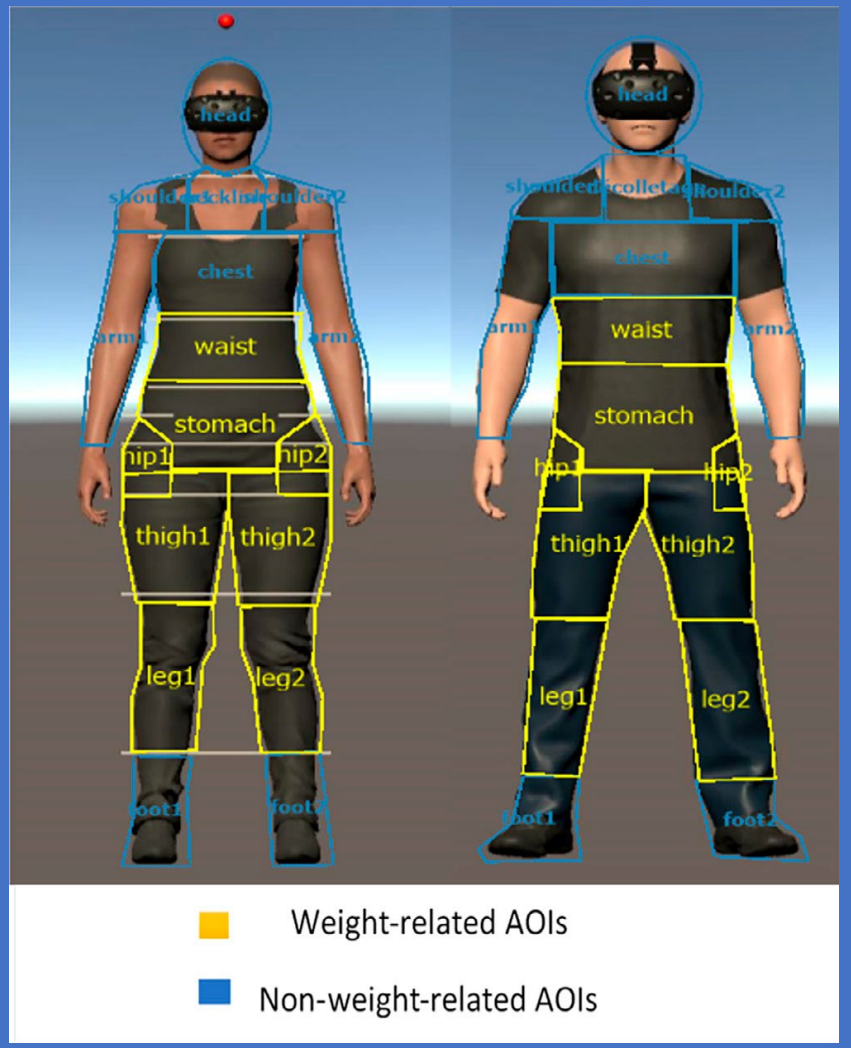
Study compared 2 groups when they owned their real-size virtual bodies.

- College female participants (n=45),
- College male participants (n=40).

Statistically significant interaction between gender and Attentional Bias (both Complete Fixation Time and Number of Fixations) ($p < .05$).

Overall, **women paid more attention to the weight-related body parts than men**, who in turn paid more attention to the non-weight related body parts (especially muscular-related body parts).

Body dissatisfaction levels did not significantly affect the results [16].




[16] Porras-Garcia, B.; Ferrer-Garcia, M.; Ghita, A.; Moreno, M.; López-Jiménez, L.; Vallvé-Romeu, A.; Serrano-Troncoso, E.; Gutiérrez- Maldonado, J. The influence of gender and body dissatisfaction on body-related attentional bias: An eye-tracking and virtual reality study. *Int. J. Eat. Disord.* ***2019***, 52, 1181–1190.

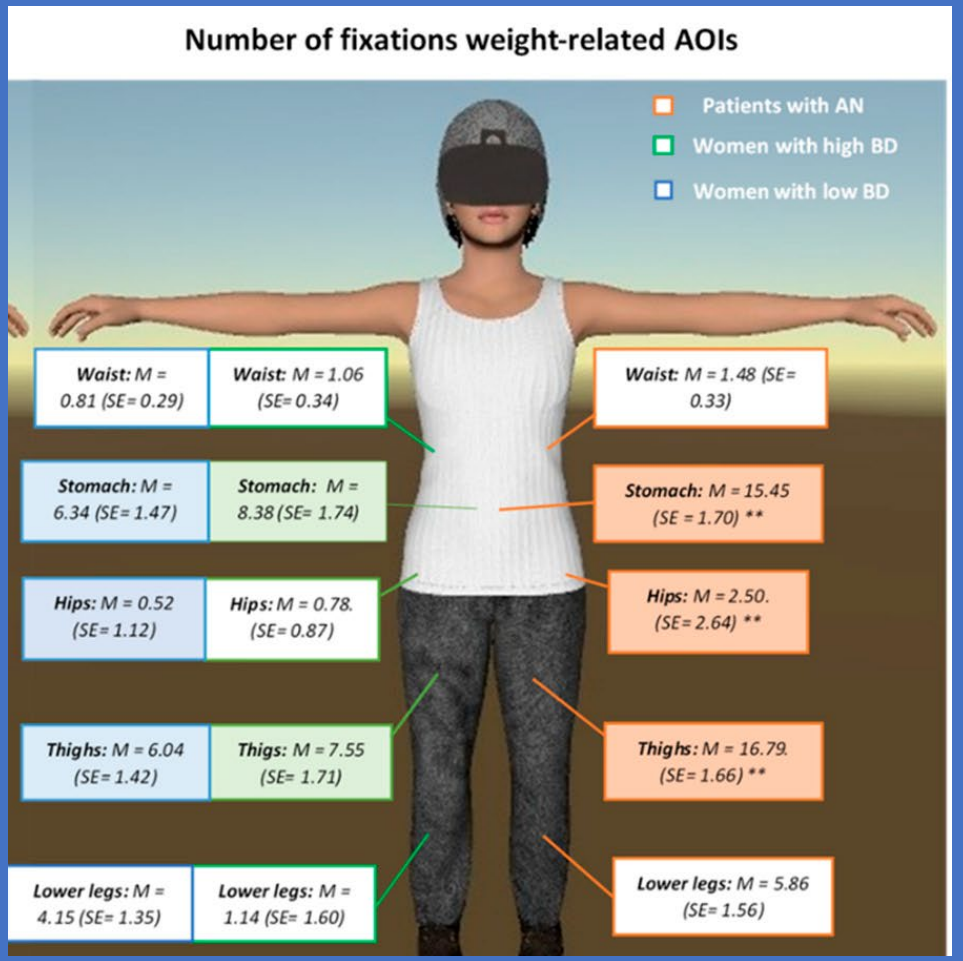
# What has already been achieved:

## *2. Validity of VR-based body exposure to elicit FGW and body anxiety in AN patients*

Study compared 3 groups when they owned their real-size virtual bodies.

- Female patients with AN (n=30),
- College women with high Body Dissatisfaction (n=18),
- College women with low Body Dissatisfaction (n=25).

Patients with AN showed higher levels of Fear of Gaining Weight (FGW), body anxiety and body-related attentional bias (i.e., toward weight-related body parts) than healthy controls [17].




[17] Porras-Garcia, B.; Ferrer-Garcia, M.; Serrano-Troncoso, E.; Carulla-Roig, M.; Soto-Usera, P.; Miquel-Nabau, H.; Shojaeian, N.; de la Montaña Santos-Carrasco, I.; Borszewski, B.; Díaz-Marsá, M.; Sánchez-Díaz, I.; Fernández-Aranda, F.; Gutiérrez-Maldonado, J. Validity of Virtual Reality Body Exposure to Elicit Fear of Gaining Weight, Body Anxiety and Body-Related Attentional Bias in Patients with Anorexia Nervosa. *Journal of Clinical Medicine* ***2020***, 9(10), 3210.

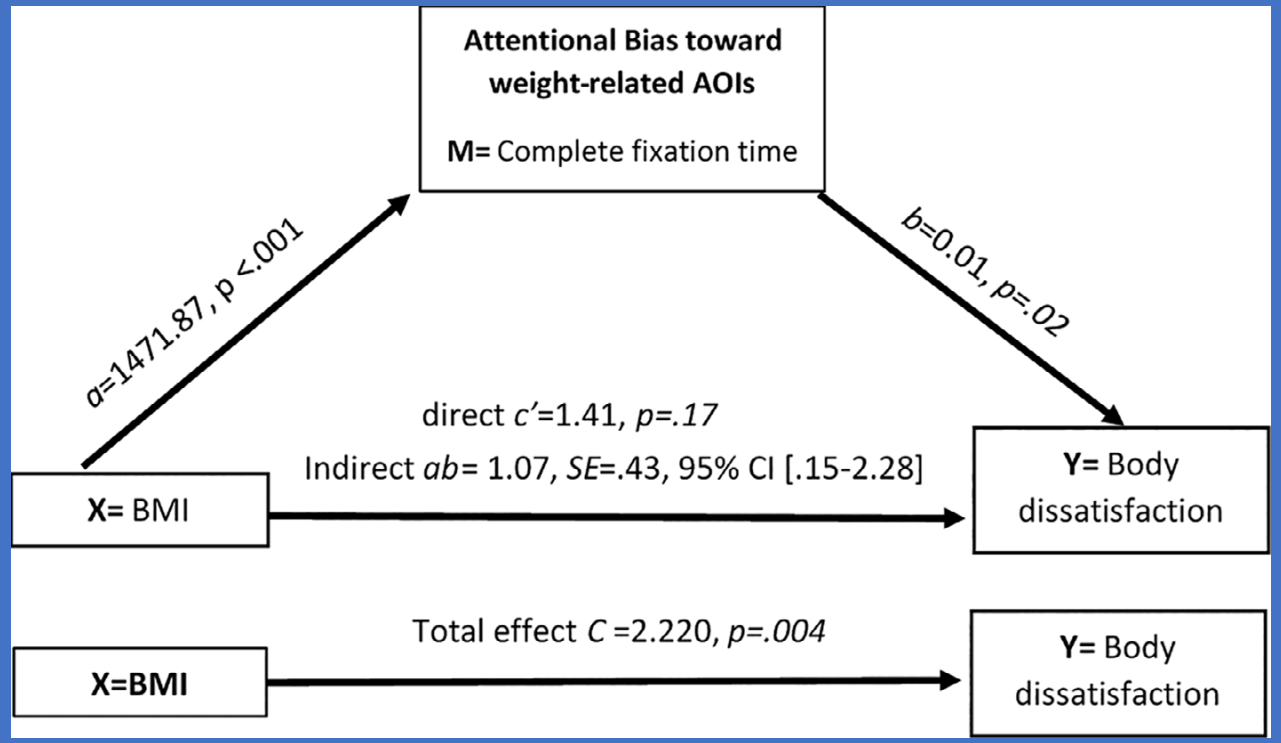
# What has already been achieved:

## *3. Body-related AB is a mediator between BMI and Body dissatisfaction*

Participants: 41 college women.

Mediation analysis revealed that **weight-related attentional bias mediated the relationship between body mass index (BMI) and body dissatisfaction** (but not body distortion).

These findings suggest that modifying weight-related attentional bias would be a useful treatment target for improving body dissatisfaction [18].




Mediational model analysis between BMI, body-related attention bias and body dissatisfaction

[18] Porras-Garcia, B.; Ferrer-Garcia, M.; Yilmaz, L.; Sen, Y.O.; Olszewska, A.: Ghita, A.; Serrano-Troncoso, E.; Treasure, J.; Gutiérrez-Maldonado, J. Body-related attentional bias as mediator of the relationship between body mass index and body dissatisfaction. *Eur Eat Disord Rev.* ***2020***, 28(4), 454-464.

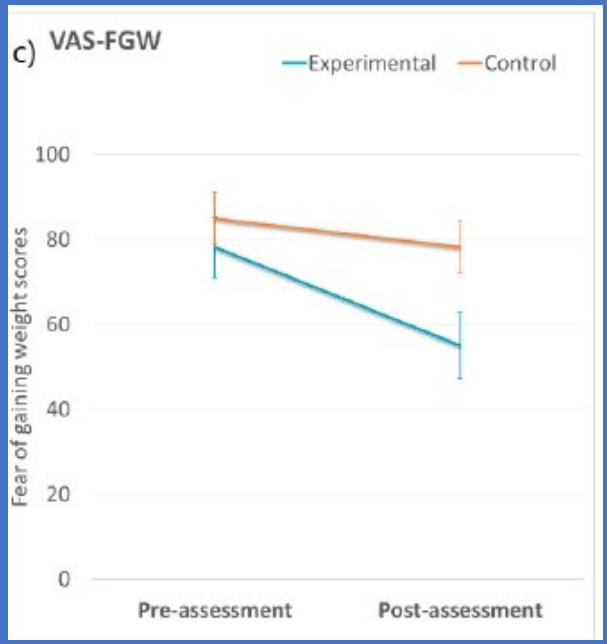
# What has already been achieved:

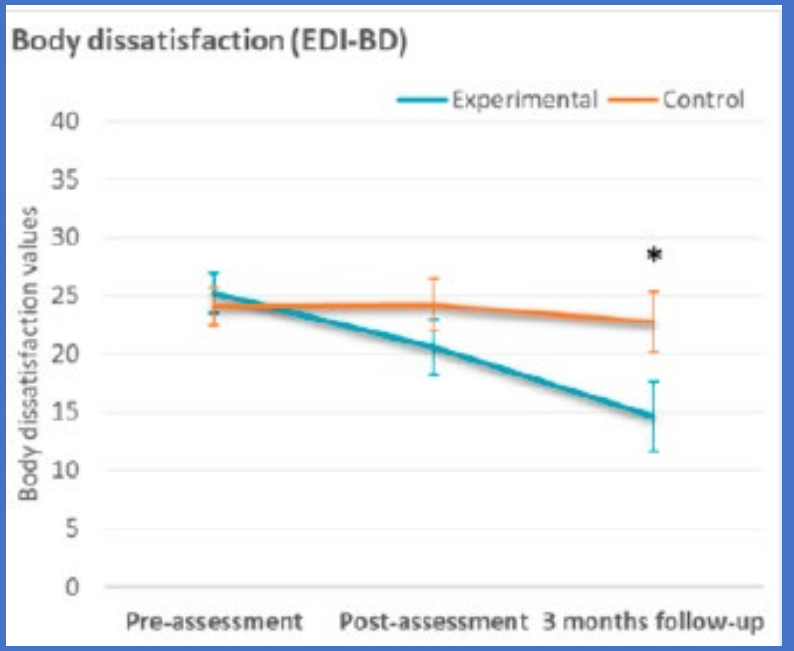
## *4. VR-based Body exposure therapy reduces FGW and Body Image Disturbances in AN patients*

Study compared:

- Control group: 19 patients with AN (TAU, i.e. *Treatment As Usual*).
- Experimental group: 16 patients with AN (TAU + 5 sessions of VR-based Body Exposure Therapy with BMI progressive increase of Virtual Body) .

After the intervention and at follow-up, the **experimental group showed significantly lower values in the FGW and BIDs** than the control group [19].



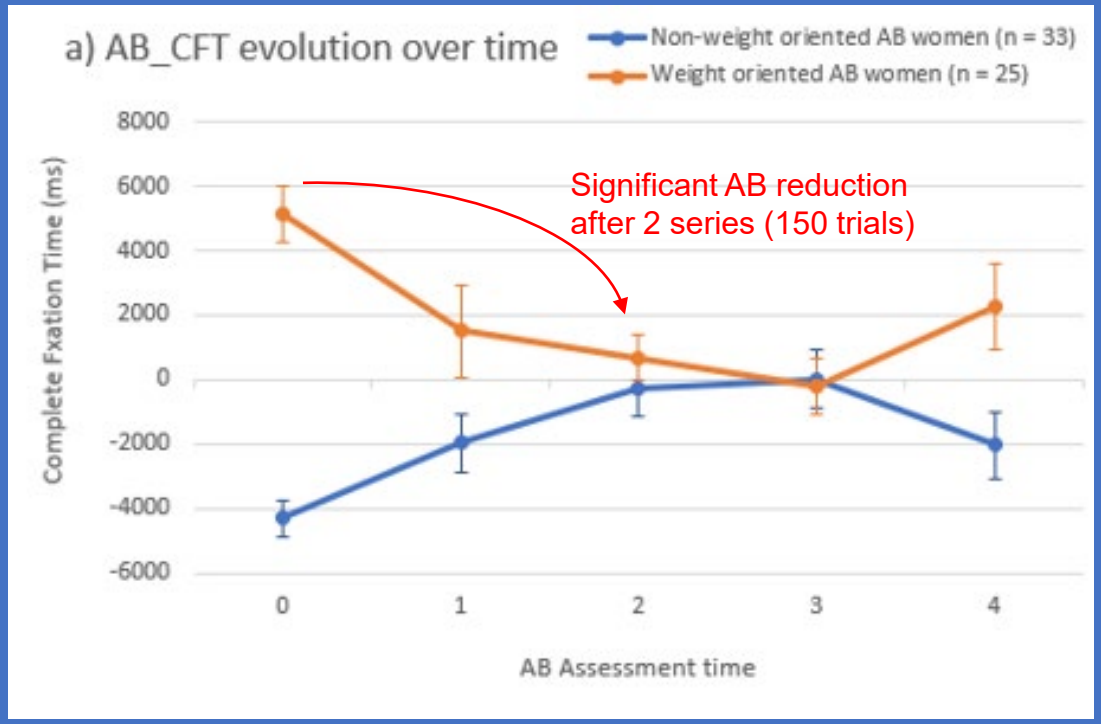

[19] Porras-Garcia, B.; Ferrer-Garcia, M.; Serrano-Troncoso, E.; Carulla-Roig, M.; Soto-Usera, P.; Miquel-Nabau, H.; Fernández-Del castillo Olivares, L.; Marnet-Fiol, R.; de la Montaña Santos-Carrasco, I.; Borszewski, B.; Díaz-Marsá, M.; Sánchez-Díaz, I.; Fernández-Aranda, F.; Gutiérrez-Maldonado, J. 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. *Journal of Clinical Medicine* ***2021***, 10(4), 682.

# What has already been achieved:

## *5: Our VR-based ABMT procedure reduces Body-related Attentional Bias (AB)*

Participants: 58 college women, divided into two groups depending on baseline AB (non-weight related predominant vs. weight-related AB 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 AB measures** (both CFT and NF) [20].




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.

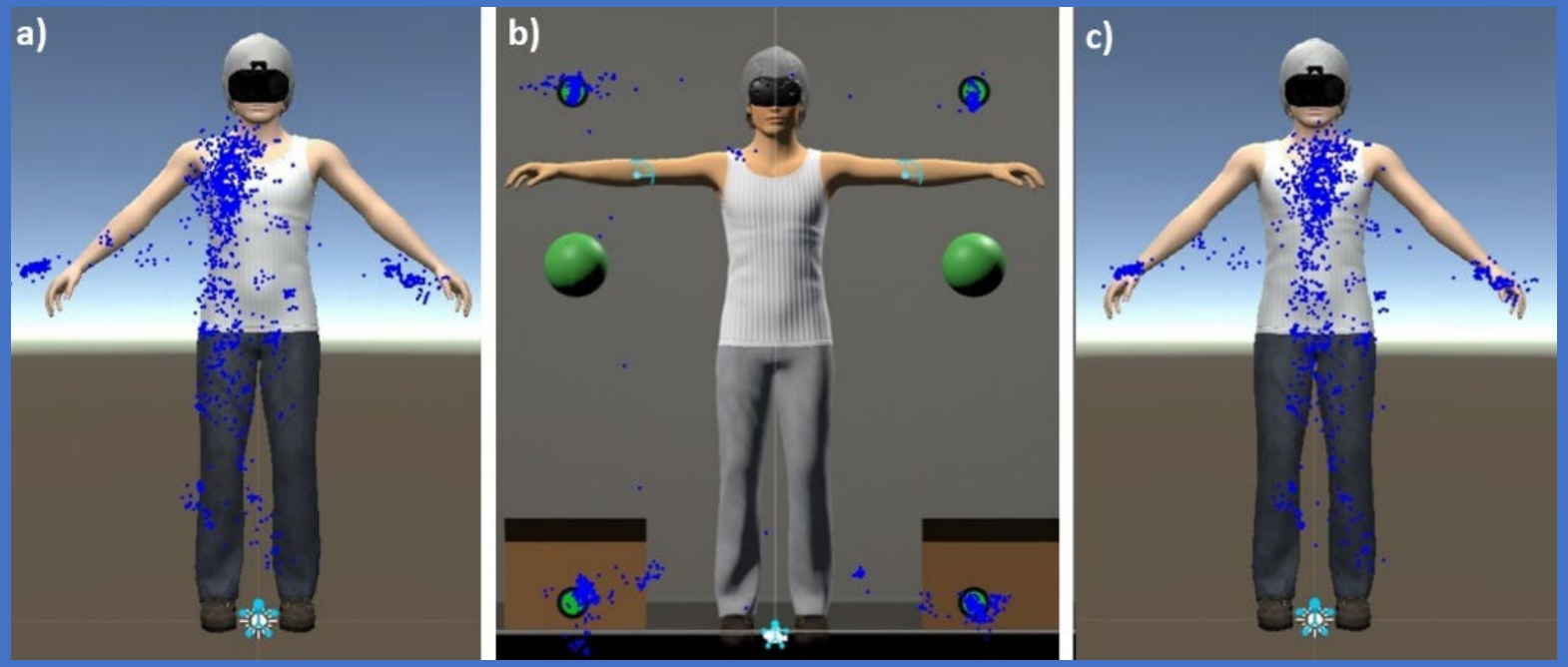

[20] Meschberger-Annweiler, F.A.; Ascione, M.; Porras-Garcia, B.; Ferrer-Garcia, M.; Miquel, H.; Exposito, E.; Serrano-Troncoso, E.; Carulla-Roig, M.; Gutierrez-Maldonado, J. (2022). A pilot Attentional Bias Modification Task, through Virtual Reality and Eye-Tracking Technologies, to enhance the Treatment of Anorexia Nervosa [Manuscript submitted for publication]. Department of Clinical Psychology and Psychobiology, Universitat de Barcelona.

# What has been already achieved: Technical improvements

Example: Drift correction

Drift effect may introduce random error in ET data (and thus in AB assessment).

We designed self-designed drift correction procedure and software to correct data for each participant and improve data accuracy.




From left to right:
a) example of RAW ET data,
b) adjustment based on four fixed “drift markers”,
c) drift-corrected

# *Work in progress*
# Ongoing: Clinical study


**Participants** (target): 75 female patients with AN

3 groups (randomized):

- **Control 1:** Treatment as usual (TAU): CBT.
- **Control 2:** TAU + 5 weekly sessions of VR-Based Exposure therapy with avatar's BMI increase.
- **Experimental:** TAU + 5 weekly sessions of VR-Based Exposure therapy with avatar's BMI increase and ABMT procedure (150 trials).

**Follow-up** session after 3 months.

**In collaboration with the Hospital San Joan de Déu (Barcelona)**

SJD Sant Joan de Déu Barcelona · Hospital

# *Work in progress*
# Ongoing: Clinical study


**Measures:**

- Attentional Bias (both CFT and NF),
- BIDs (both body dissatisfaction and body distortion),
- Fear of gaining weight (FGW) and Body Anxiety,
- Body Mass Index (BMI).

**Main objective :**
Analyze the increase in the efficacy of usual treatment by intensifying it with the addition of a VR-based body exposure component and by adding a VR-based attentional bias reduction component.

**In collaboration with the Hospital San Joan de Déu (Barcelona)**

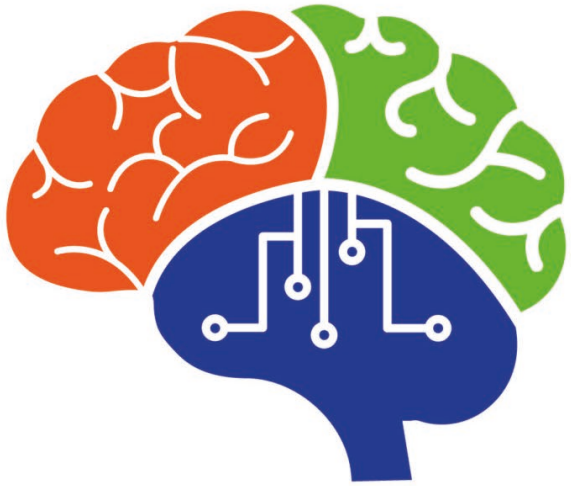
SJD Sant Joan de Déu Barcelona · Hospital

**Preliminary results of clinical pilot study** are promising: significant reduction of AB (Complete Fixation Time) on weight-related body parts and of body dissatisfaction levels.
*(=> Flashtalk of Ms. Mariarca Ascione)* [21].

[21] Ascione, M.; Carulla-Roig, M.; Miquel, H.; Porras-Garcia, B.; Meschberger-Annweiler, F.A.; Serrano-Troncoso, E.; Ferrer-Garcia, M.; Gutierrez-Maldonado, J. (2022). Validity of an Attentional Bias Modification Training based on Virtual Reality and Eye-Tracking in Anorexia Nervosa patients [Manuscript submitted for publication]. Department of Clinical Psychology and Psychobiology, Universitat de Barcelona.

# Conclusions

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.



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# *Thank you!*


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