

Body-related attentional bias in anorexia nervosa and body dissatisfaction in females: An eye-tracking and virtual reality study

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Research project

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Department of Clinical Psychology and Psychobiology (Personality, Assessment and Psychological Treatment Section)

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Objective

Recent research suggests that there is a tendency in eating disorder (ED) patients of checking the unattractive body parts. However, little research uses the attentional bias (AB) phenomenon together with virtual reality (VR) to focus in this pathological behavior and body dissatisfaction (BD) controls. The aim of this study is to examine whether anorexia nervosa (AN) patients specifically have a longer fixation time and more number of fixations on the weight-related body parts compared to healthy sample with high and low levels of body dissatisfaction using the collected data of eye tracking AB measures taken from the observation of VR avatar with the real silhouette of each participant.

Hypothesis

Patients with anorexia nervosa will have more time and number of fixations to weight-related body parts than healthy patients. On the other hand, the group with high body dissatisfaction (HBD) will have more fixations and will be more time looking at the parts related to the weight than the low body dissatisfaction (LBD) group.

Method

Forty-three college women (18 with high BD and 25 with low BD) and 23 anorexia nervosa patients were embodied in a personalized virtual avatar with their own BMI data (calculated with the weight and height measurements taken previously) while eye movement data was tracked through an Eye-Tracking device incorporated in the virtual reality headset (FOVE). The number of fixations and the complete fixations time was focused on the weight-related areas of interest (W-AOIs) and non-weight-related areas of interest (NW-AOIs).

Results

Evidence was found that patients with AN display longer and more frequent gazes towards W-AOIs than both groups of healthy participants, who did not show any statistically differences in the visual selective behavior between the NW-AOIs and the W-AOIs.

Conclusions

These findings support the conclusions that a negative body information processing or/and gazing the weight related body parts entailing to unhealthy behavior patterns.

KEY WORDS: Attentional bias, body dissatisfaction, anorexia nervosa, virtual reality, body image.

INTRODUCTION

Anorexia nervosa is one of the most prevalent eating disorders in the population and its diagnosis in women has increased in the last two decades (Dahlgren & Wisting, 2017). The peak onset of AN is during the adolescence and early adulthood with a ponderance in girls and women (Treasure, Duarte & Schmidt, 2020).

Regarding to the treatments of the disease, the current services have an insufficient equipment to deal with such severe, long term disorder (Hudson, Hiripi, Pope & Kessler, 2007) and the patients of AN often do not respond effectively to the treatment (Herzog, Keller, Zucker, Strober, Yeh, & Pai, 1992). As Hudson, et al. (2007) says, innovation and progress are urgently needed for a successful cure for AN.

Body image distortion (BID) is a central symptom of Anorexia Nervosa (Beato-Fernández, Rodríguez-Cano, Belmonte-Llario & Martínez-Delgado 2004), and can be considered one of the principal risks in the development of the disease (Gaudio, Brooks & Riva, 2014). As it is specified in the DSM-5, AN patients perceive their body or body parts as being too fat, even if they are in a severely emaciated state (APA, 2013). Body Dissatisfaction (BD) (Banfield, & McCabe, 2002) is referred to the apparent overestimation and the feelings an individual has about his or her body (Gleaves, Williamson, Eberenz, Sebastian & Barker, 1995), introducing strong negative feelings toward own appearance (Wilhelm, Hartmann, Cordes, Waldorf, & Vocks, 2018). BD is emphasized and maintained by the phenomena of body checking this being the practice of repeatedly checking the one's body, scoping selective body parts, frequently weight, and looking on-self in the mirror repeatedly (Reas, Whisenhunt, Netemeyer, & Williamson, 2002).

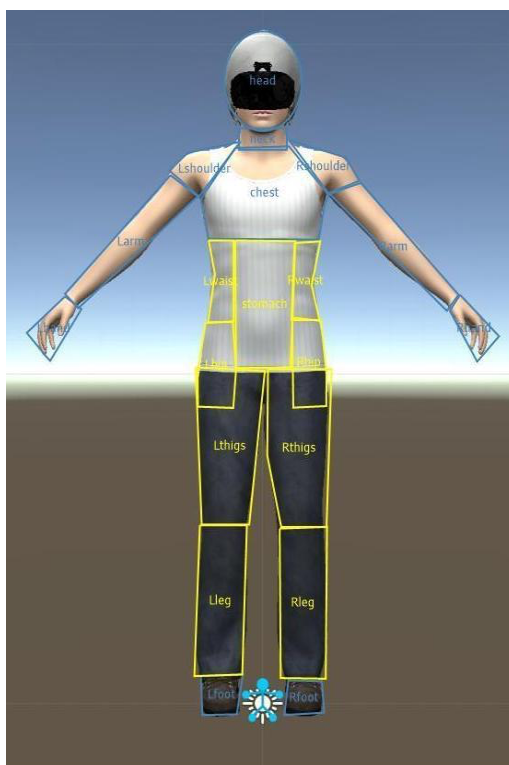
Previous studies confirm the behaviors and cognitions of body checking as a potential of the etiology and maintenance of eating disorders (ED) (Mountford, Haase, & Waller, 2006) that are underserved in treatment programs (Rosen, 1997).

But, how to identify this specific behavioral pattern and traduce these practices into analysable data? Eye tracking (ET) is a technology that measures eye movement and has been recently applied to provide insights into cognitive, social and emotional development in psychiatric disorder processes (Kerr-Gaffney, Harrison & Tchanturia, 2019). Thanks to the advantages in gestural recognition hardware of 3D avatars in virtual reality (VR), technology can capture full-body motion to guarantee the immersive experience using VR-based embodiment techniques and producing the feeling that the artificial body it is the participant's body, known as the paradigm of the full body ownership illusion (FBOI). Also, there are evidences that FBOI applied in VR produces cognitive changes in body dissatisfaction (Ferrer, Porras Garcia, Moreno, Bertomeu & Gutiérrez Maldonado, 2018). It has been demonstrated in previous studies the existence of differences in eye movement patterns between AN patients and non-clinical samples with different body dissatisfaction levels: women high in BD showed sustained attentional maintenance to thin bodies (Gao, Deng, Yang, Liang, Liu & Chen, 2014), eating disorder individuals have a longer fixation time for body areas they find unattractive (Bauer, et al., 2017; Tuschen-Caffier, Bender, Caffier, Klenner, Braks & Svaldi, 2015), more precisely in the areas of the stomach and hips (George, Cornelissen, Hancock, Kiviniemi & Tovee, 2011). The current study ensures that the results are in line with our objective; by making the division of the weight areas of interest (W-AOIs) and the non-weight areas of interest (NW-AOIs) the potential AB studied is going to be towards the areas related to weight and in this way, it would be possible to objectively measure the type of attentional bias that it is proposed in the objectives of this study.

The aim of the current study is to provide further information about the differences in the AB between AN patients and healthy individuals with different levels of body dissatisfaction using together this two techniques. Based on previous studies, it is expected that AN patients should have a gaze pattern focused on weight-body areas, as well as HBD (lesser extent than the previous ones) compared to LBD participants, that show a more general gaze scanning behavior of their own body; adding the contribution of the new techniques to analyze this phoneme so more valid conclusions can be drawn.

Method

Forty-three college women (18 with high BD and 25 with low BD) from University of Barcelona and 23 anorexia nervosa patients diagnosed at the Eating Disorder Units of Hospital Sant Joan de Déu of Barcelona and the Hospital of Bellvitge, were embodied in a personalized virtual avatar with their own BMI data (calculated with the weight and height measurements taken previously) while eye movement data was tracked through an Eye-Tracking device incorporated in the virtual reality headset (FOVE). The number of fixations and the complete fixations time was focused on the weight-related areas of interest (W-AOIs) and non-weight-related areas of interest (NW-AOIs). The EDI-BD (of the EDI-3 [EDI-3; Garner, 2004]) scale was used to assess the BD in the study and for the eye-tracking measures the questionnaire of Physical Appearance State and Trait Anxiety Scale (PASTAS) (Thompson, J. K., 1999) was used. The data of weight areas of interest (W-AOIs) and no weight areas of interest (NW-AOIs) was divided based on this questionnaire.



The procedure consisted first of all, of signing the informed consent (by the participants or by the

Figure 1: Visual figure of the weight-related Areas of Interest (in yellow) and non-weight-related areas of interest (in blue) in the virtual avatar

legal guardians of the participants under the age of 18). Then, the weight and the height of the

healthy participants was measured to be able to calculate their BIM [weight (in kilograms)/ height (in meters) ²]. After creating the idiosyncratic avatar for each participant, the EDI-3 questionnaire was filled and the feet and hand trackers were putted to the participant as well as the HTC-VIVE headset. In order to make the visuo-motor stimulation procedure, and once the participant was in the virtual environment seeing their avatar, the investigator gave instructions to the participant to look himself and in the mirror and to make a sequence of body movements that lasted a total of one and a half minutes. On the other hand, the participants were touched with the tactile controller of the HTC-VIVE in the arms, legs and stomach, while there were watching the same action at the same time in their virtual avatar in order to synchronize a visual and tactile stimulation with the avatar. In that way a full body illusion (FBI) was created. For measuring the eye-tracking measurements the participants were asked to change the HTC-VIVE headset to the VR HMD-FOVE-Eye Tracking, always being in the same virtual environment. In that way the eye movements patterns were tracked.

DATA ANALYSIS

To prepare the Eye-Tracking data analysed in the current study for the statistical analysis, Ogama software (Open Gaze Mouse Analyser) was used. The EDI-BD test was used to determinate the body dissatisfaction levels of the healthy sample. Women were divided into high vs low BD levels using the median score of the EDI-BD as a cut-off point (MeBD = 8).

All the statistical analysis were performed using the software IBM SPSS v.26. One-way ANOVA was conducted to determine if the three different groups (AN, HBD and LBD participants) has differences in the attentional bias measures, only including the number of fixations (NF) and the complete fixation time (CFT) data. Significance was set at $p < 0.05$.

Results

Evidence was found that patients with AN display longer and more frequent gazes towards W-AOIs than both groups of healthy participants, who did not show any statistically differences in the visual selective behavior between the NW-AOIs and the W-AOIs.

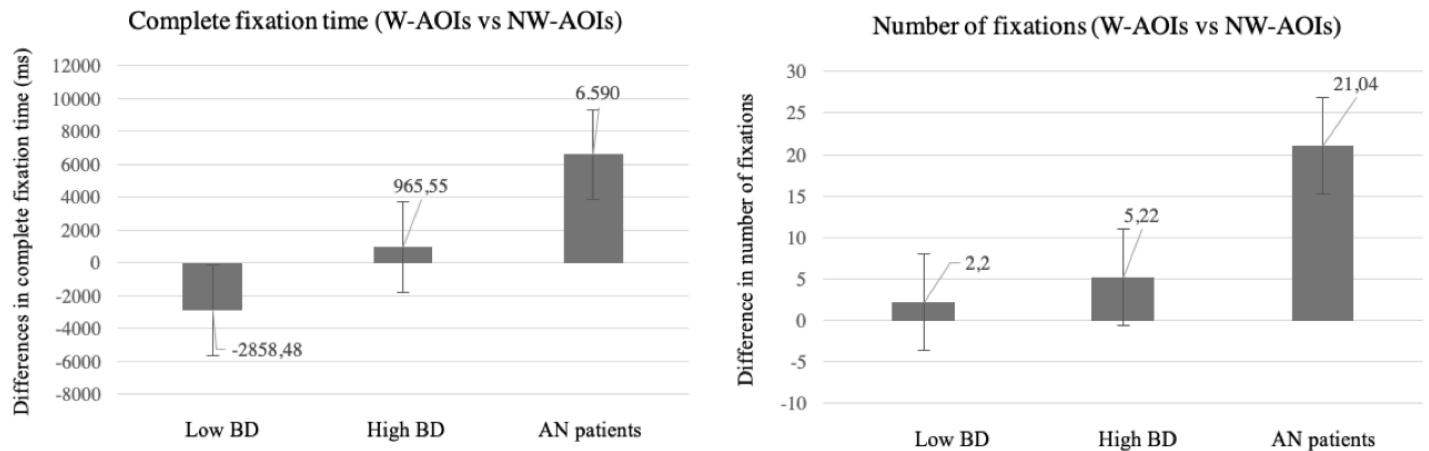


Figure 2: Group differences in mean complete fixation time (ms) (in the left), and number of fixations (in the right) at weight vs non weight AOIs. Error bars represent SE, based on 2SE. BD body dissatisfaction; AN, anorexia nervosa; AOIs areas of interest.

DISCUSSION

The current study aimed to assess body-related attentional bias toward weight-AOIs and non-weight AOIs in women with anorexia nervosa and healthy participants by using an eye tracking device for the AB measurements, virtual idiosyncratic bodies of the participants and embodiment illusion.

As expected, results confirmed that AN patients had more number of fixations and a longest complete fixation time in the W-AOIs than healthy controls, that displayed a uniform distribution of eye gaze in the two divided areas of the body. Nevertheless, between high and low body dissatisfaction groups no significant differences in the AB between W-AOIs and NW-AOIs were found. The results observed in the AN group regarding the attentional bias are in line with previous studies (Bauer et al., 2017; Mountford, 2006; George, et al., 2011; Freeman, Touyz, Sara, Rennie, Gordon & Beumont, 1991; Tuschen-Caffier et al., 2015).

As the outcomes of the study shows, there are differences in the way of processing information between AN patients and the healthy controls. A possible explanation to these results is that AN patients have an altered capacity of processing and integrating body representation

perceiving their body parts not in a holistic way, but in a dissociated view (Gaudio, Brooks, & Riva, 2014). This could create a vicious circle, as the theory says (Williamson, White, York-Crowe & Stewart, 2004), a stronger attentional bias to the unattractive body parts may lead to an emphasis to the negative body image creating thus, an unfavourable cognitions and emotions for the patient, plunging her deeper into the disease.

It is also important to consider the way body experiences are stored in memory of AN, especially the sensory-motor/proprioceptive memory. Studies suggest that AN patients are stuck in a negative allocentric view of their body and this may lead to an insufficient egocentric/somatosensorial body updating, producing an alteration of the way they experience and remember their shape (Riva & Gaudio, 2012). In addition, this alteration will also be related with a biased long-term storage since the orientation and position of body parts will be saved incongruously between presentation and recall (Burgess, Becker, King & O'Keefe, 2001). Brain imaging studies support these conclusions as a deterioration it has been found in the areas between the parahippocampus and the precuneus in AN patients, the same areas that process an allocentric/egocentric view of the body. Studies show that body image-related cognitive biases can be manipulated (Rodgers & DuBois, 2016), and according to these last findings, VR therapy could work compensating this brain malfunction as the patient is seeing her virtual avatar in an allocentric position towards the mirror; so it could be treated bias information processing with these new technologies.

This alteration of the space experience also may lead females to perceive the negative areas of their body as defining of their self, specially adolescents, as young girls are exposed and more susceptible to cultural and social messages and pressures concerning the body. In the same way, cultural and social pressures will affect this vulnerable group more than healthy people. This may increase the body checking.

Future studies should focus on the modification of the reported patterns applying virtual reality technology that could serve as innovation anorexia nervosa attentional bias therapies with the correction of the ecological validity by helping patients to become more aware of their attention biases. It may also be a guide to objectively determinate the improvement in the patient's dissatisfaction in their body shape following treatment. What is more, it may serve as a focus on a prophylactic function in females with high body dissatisfaction who are at risk of developing eating disorders. Moreover, future directions would include studying this paradigm in a larger and

a more representative sample in participants with different levels of body dissatisfaction and in patients with AN.

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