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The Impact of the Out of Body Illusion on Body Dissatisfaction in Anorexia Nervosa

An explorative study.

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Abstract

Objective. Body image distortions are a core element of anorexia nervosa (AN) and often lead to body dissatisfaction. Body dissatisfaction increases the chances of relapse and the treatment of it is difficult. Treatment often entails cognitive and affective techniques. The aim of the current study is to investigate the following hypotheses: 1) whether the out of body illusion (OBI) task, a virtual reality task rooted in experimental psychology, decreases the amount of body dissatisfaction in patients with AN and 2) whether the effect of the illusion is related to the change in body dissatisfaction. It is also examined whether 3) the levels of embodiment, the degree to which participants identify with the virtual body, play a role in the amount of change in body dissatisfaction when the OBI was induced. **Method.** Fifteen AN patients completed the Body Satisfaction Scale (BSS), the OBI task, and a self-constructed questionnaire called the Embodiment Questionnaire (EQ). **Results.** A certain trend towards significance was found for the first hypothesis, suggesting a decrease in body dissatisfaction after the OBI task was conducted. No significant effects were found for the second and third hypotheses. **Discussion.** The trend towards significance suggesting a decrease in body dissatisfaction calls for further research. Future research should mainly aim to recruit larger samples and to validate the used measures. Furthermore, it would be interesting to explore whether multiple sessions prove to be more effective. Current study offers a good starting point and new directions to a better understanding of body image distortions and of how tasks rooted in experimental psychology might aid in reducing those distortions.

Introduction

Body image distortions are a core element of anorexia nervosa (AN). Body image distortions are very complex and can be harmful as they can lead to body dissatisfaction (Fairburn, 1997). Research shows that body dissatisfaction is both a risk and maintenance factor in eating disorders and also increases the risk of relapse (Carter, Blackmore, Sutandar-Pinnock, & Woodside, 2004; Keel, Dorer, Franko, Jackson, & Herzog, 2005; Stice & Shaw, 2002). As relapse is common in AN (Carter et al., 2004), further research into how to reduce body dissatisfaction is useful.

Body dissatisfaction is defined by a negative subjective evaluation of one's own body. This includes both one's figure and weight. It is different from body image distortions, in which patients evaluate their body to be bigger than it is (Stice & Shaw, 2002). It is also different from over-evaluation of the importance of weight and shape in determining self-worth. Both are indeed elements often seen in AN, however they should be differentiated from body dissatisfaction (Stice & Shaw, 2002). Body dissatisfaction seems to primarily originate from social and cultural pressures on women to meet the ideal of thinness that occurs in the Western society and the internalisation of that ideal. Continual messages that one has to conform to the aesthetic ideal may lead to an increase in body dissatisfaction. The role of body dissatisfaction in elevating the chances of developing an eating disorder is twofold: it is thought to lead to dieting, as an attempt to change one's body, which increases the risk of developing disordered eating. It is also thought to increase negative affect, which enhances the chances of using food to soothe unpleasant feelings. Research shows that focusing more on body dissatisfaction during treatment might enhance treatment outcomes (Stice & Shaw, 2002). One study shows that elevated body dissatisfaction shows lessened results in cognitive behavioral therapy, which is the treatment of choice in bulimia nervosa (Wilson et al., 1999). Understanding the impact of body dissatisfaction on the maintenance of eating disorders is warranted, as only a minority of patients who received treatment also experience a lasting decrease in symptoms and relapse is common.

There is an extensive amount of research on body image in AN, yet there is no real consensus on what the definition of body image is. It is beyond the scope of this thesis to list all the different definitions, however an accepted view on body image divides it into two separate sub-representations: perceptual body image and attitudinal body image (Mohr et al., 2010). Perceptual body image signifies how the body is perceived in size and shape, whereas attitudinal body image refers to cognitive and affective appraisal of the body. What most of the different definitions have in common is that they propose the way we experience our

body is influenced by multiple sensory modalities (Keizer, Van Elburg, Helms, and Dijkerman, 2016). In AN, there seem to be inconsistencies between the body as it is represented in the mind and the actual measures of the body (Cash & Deagle, 1997). The study of Keizer and colleagues showed that patients do not only visually perceive themselves to be bigger than they are, but they also register tactile information and move their body in a distorted manner that fits a larger body (Keizer et al., 2011; Keizer et al., 2013). Recent research (Lantz, Gaspar, DiTore, Piers, & Schaumberg, 2018) states that a larger gap between the actual measures of the body and the representation in the mind could result in higher body dissatisfaction. This could lead to the maintenance of eating pathology.

Distorted body image in AN is difficult to treat and frequently remains unchanged after treatment. This may be due to the fact that current treatment methods mainly teach patients to restructure the cognitive evaluation of their bodies. This seems to be insufficient, as it seems that body image is not solely created on a cognitive level: patients remain physically experiencing their body as bigger than it is (Keizer et al., 2016). To ensure more fruitful treatment results and less relapse, something else might be needed.

Research has shown that although body image disturbances in AN are a primary aspect of the disorder, they can be reduced using certain tasks rooted in experimental psychology. For example, Rubber Hand Illusion (RHI) studies show that patients are more susceptible to the effect of illusion than healthy controls (Keizer, Smeets, Postma, Van Elburg, & Dijkerman, 2014). They also made more accurate estimations of the size of their actual hand after the illusion was induced. Research also demonstrates that after participating in a Full Body Intervention (FBI) in which patients wore virtual reality goggles through which they saw a virtual body, they were able to more accurately estimate their own actual body size. This implies that, however difficult, it is indeed possible to make changes in the estimations of actual body size (Keizer et al., 2016). These results indicate potential treatment opportunities for body image disturbances through multi-sensory body illusion tasks.

A promising intervention through which body illusions can be implemented in the treatment of patients is the use of virtual reality (VR). The use of VR is not new in the eating disorder field: a systematic review of the use of virtual reality shows that it is an acceptable and promising tool in treating patients with eating disorders (Clus, Larsen, Lemey, & Berrouiguet, 2018). It provides a safe environment in which the unexpected can be controlled. Additionally, it appears to help foster the therapeutic alliance. Several virtual reality studies have shown that it can induce a better ability in AN patients to accurately estimate their body size. Clus et al (2018) also discuss a study (Riva, 2011) in which it is

argued that patients are not able to update a negative body image with sensory motor and proprioceptive input alone and that the use of virtual reality methods could help them unlock this ability.

One way to show that body image can be subject to change using VR techniques that has recently gained more attention is the Out of Body Illusion (OBI). According to Ehrsson (2007), the definition of OBI is as follows: “ a perceptual illusion in which individuals experience that their centre of awareness, or ‘self’”, is located outside their physical bodies and that they look at their bodies from the perspective of another person” (p. 1).

During an OBI experiment one stands in front of a camera, wearing virtual reality goggles through which they see the images captured by the camera. This set-up results into them viewing themselves from the back, creating the illusion of looking at oneself from a distance (Lenggenhager, Tadi, Metzinger & Blanke, 2007). The study of Petkova, Khoshnevis, & Ehrsson (2011) shows that while the body is perceived to be located outside the self, self-identification with the body is maintained. This combination of localising one’s body outside oneself while identifying it as one’s own results in the experience of viewing oneself from a third person perspective. As research shows that the ability to estimate own body size is distorted in AN, while estimating the size of others’ body remains unchanged, this third person perspective is expected to create a more objective view of the own body (Guardia et al., 2012).

As self-identification with the body is maintained, it is expected that the new, objective view of the body will lead to an update of the body image to an image that is often thinner than the patient had envisioned in their minds. Preston & Ehrsson show in their study that illusory ownership of a slimmer body results in a more positive rating on body satisfaction (2014). If patients are able to perceive their actual, slim body it is thought to decrease their feelings of body dissatisfaction.

How perception of the illusory body takes place, however, might be dependent on the level of self-identification with the body one experiences, also referred to as embodiment. In other words: how much do they feel the body they are looking at is their own. Thus far, research about the role of embodiment in body illusions is equivocal. For example, the study of Haggard & Jundi (2009) suggests that embodiment is crucial to alter perceptions, while Keizer et al. (2016) show in their study that there seems to be no connection between embodiment and the effect of the illusion. The outcome might be different in the current study as the mentioned studies used fake bodies and body parts whereas participants see their own body in an OBI. The study of Lenggenhager et al. (2007) seems more comparable to the

current study: they show that the drift towards the virtual body is insignificant when embodiment is lessened, suggesting less impact of the out of body illusion when embodiment decreases.

The OBI experiment is relatively new and so far, no studies are published on the effects of OBI on body image in patients with AN. Therefore, the current study primarily aims to measure whether inducing an OBI can indeed be a useful way to decrease the levels of body dissatisfaction in patients with AN. Thus, we hypothesise that AN patients would score higher on the body satisfaction scale after the OBI task was implemented. We also hypothesise that the effect of the OBI would be related to the change in body dissatisfaction.

The second aim of the current study is to test whether the levels of embodiment played a role in the amount of change in body dissatisfaction when the OBI was induced. It is hypothesised that the level of experienced embodiment would moderate the change in body dissatisfaction after the OBI was induced.

Methods

Participants

Seventeen participants were recruited for this study, however the data of two participants were eventually left out. One participant did not complete the study: seeing herself through the goggles caused her to become very emotional after which was decided that she would stop prematurely. The other participant's data was decided to be excluded because it proved to be an outlier on the variable difference in the before and after scores on the Body Satisfaction Scale (BSS) in the sample. Fifteen participants (one male) were included in the final sample, who were all but one diagnosed with anorexia nervosa (AN). One participant was diagnosed with other specified eating or feeding disorder (OSFED) with a clinical presentation resembling AN. The participants had a mean age of 26.53 (SD= 9.33) with a range of 18 to 48 years old. The mean BMI was 16.39 (SD= 2) with a range of 13.0 to 20.3. Participants were recruited from the Dutch regional national mental health care organisation Altrecht Rintveld, specialised in eating disorders. Inclusion criteria were that participants had to be at least 18 years old and were diagnosed with AN or OSFED with a clinical representation resembling AN. Exclusion criteria were minimised as to recruit a big enough sample. Exclusion criteria were conditions that could interfere with hearing and/or seeing such as blindness or deafness. The study was approved by the 'Medisch Ethische Toetsingscommissie' (METC), an independent medical ethical committee. The experiment

had a within-subjects design, where the participants completed the Body Image Scale before and after the OBI task was induced.

Procedure

Participants first filled out the Body Satisfaction Scale after which the OBI task was executed. Participants then received an explanation of the procedure and were asked to put the virtual reality goggles (Oculus Rift DK2) on and take position in front of the camera, at a distance of 2 meters. The camera was placed at eye level of the participant. The participants then saw their own backs through the goggles, which had two lenses, creating 3D vision. A period of 30 seconds followed to get accustomed to the perspective. Then 60 seconds followed in which the participant was asked to stand still and look straight ahead at themselves. The goggles were then removed. Figure 1 shows the set-up of the out of body experiment. After the experiment, they were instructed to fill out the Body Satisfaction scale once more, followed by the Embodiment Questionnaire.

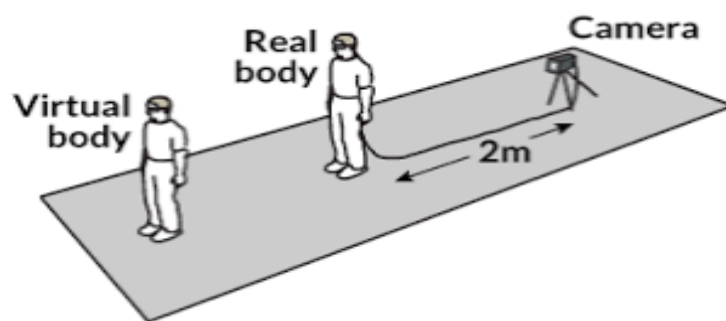


Figure 1: Set up out of body illusion experiment (Cowie et al., 2017)

Materials

Body Satisfaction Scale (The Lichaamstevredenheid Schaal) (BSS)

Participants were asked to indicate the amount of body satisfaction they experienced at that moment on the Body Satisfaction Scale. The scale was a visual analogue scale, with on the left the word ‘dissatisfied’ and on the right ‘satisfied’. It was scored on a 0 – 100 scale.

Embodiment Questionnaire (EQ)

After having completed the experiment, the participants were asked to fill out the Embodiment Questionnaire. The EQ was created specifically for the current study. We adopted several items from a questionnaire by Ehrsson (2007). The EQ contains 10 questions

which can all be rated on a scale from ‘Totally disagree’ (0) to ‘Totally agree’ (10). Of the 10 questions, 4 were illusion-related questions (does one experience feelings of displacement, as if looking at oneself from a different perspective), 3 were control questions added to measure suggestibility and 5 were embodiment questions (does one recognize one’s own body standing there). Cronbach’s alpha was calculated for all the subscales. The illusion subscale had poor internal reliability (.53), the suggestibility scale showed poor to good reliability (.61) and the embodiment subscale achieved acceptable to good reliability (.72). The score was calculated by dividing the sum of the questions for each condition by the amount of questions in that particular condition. The items were rated on a 10-point Likert scale.

Analysis

The results were analysed using IBM SPSS Statistics 22. To test whether the OBI task would decrease body dissatisfaction, a dependent t-test was used with the before and after scores on the BSS as the variables. To test how much the change in body dissatisfaction was related to the effect of the illusion induced in the experiment, a Pearson correlation was performed, using the scores of the EQ that were related to the effect of the OBI and the difference in the before and after scores on the BSS. To test whether the amount of experienced embodiment moderates the decrease of body dissatisfaction after the OBI task, a multiple regression analysis with an interaction element was performed with the difference in the before and after scores on the BSS as the dependent variable. The scores of the EQ that were related to embodiment and the scores of the EQ that were related to the effect of the OBI were used as the independent variables and the interaction between the embodiment and OBI effect scores of the EQ as a third independent variable.

Results

We first hypothesised that AN patients would score higher on the BSS after the OBI task was implemented. We visually inspected the relevant histograms to check the assumptions of normality and normality of difference scores. The inspection of the data showed that one participant proved to be an outlier, causing the violation of the assumption of normal distribution of the variable difference in the before and after scores on the BSS. The participant’s data was therefore deleted from the analysis. A dependent t-test showed a certain trend towards significance in the change in body dissatisfaction from before the task ($M=9.96$, $SD=8.42$) compared to after the task, ($M=17.00$, $SD=15.83$), $t(14)=-1.89$, $p=.079$,

showing a decrease in body dissatisfaction after the OBI task. See table 1 for descriptive statistics.

Secondly, we hypothesised that the effect of the OBI would be related to the change in body dissatisfaction. Inspection of the assumptions of normality, linearity and homoscedasticity through visually inspection of the Q-Q plots (normality) and a scatterplot (linearity and homoscedasticity) showed that these were all met. A Pearson correlation showed that no significant correlation exists between the effect of the illusion created by the OBI and the change in body dissatisfaction $r(14) = -.29, p = .297$. See table 2 for descriptive statistics.

Finally, it was hypothesised that the level of experienced embodiment would moderate the change in body dissatisfaction after the OBI was induced. The assumptions of normality of the variables, outliers (through Mahalanobis distance) and multicollinearity were assessed. Second, the normality, linearity and homoscedasticity of the residuals were evaluated. The assumptions were all met. A multiple regression showed that embodiment did not significantly moderate the change in body dissatisfaction after the OBI, $F(3, 11) = .778, p = .530$, with an R^2 of .175. See table 2 for descriptive statistics. No significant main effect was found for the effect of the illusion on change in body dissatisfaction, $\beta = -.238, t = -.841, p = .418$. Furthermore, no significant main effect was found for embodiment on change in body dissatisfaction, $\beta = -.163, t = -.566, p = .583$. Finally, no significant effect was found for the interaction between the effect of the illusion and embodiment on change in body dissatisfaction, $\beta = -.312, t = -1.067, p = .309$.

Table 1

Descriptive statistics Body Satisfaction Scale Scores

	Mean	SD	Minimum	Maximum
Before Score	9.96	8.42	0	26
After Score	17.00	15.83	0	36

Table 2

Descriptive statistics Embodiment Questionnaire Scores

	Mean	SD	Minimum	Maximum
Effect illusion	6.13	1.43	3.5	9.5
Embodiment	6	1.87	2.4	9.8

Discussion

This study is the first to explore the effects of the OBI on body dissatisfaction in AN. We hypothesised that 1) the OBI task would lead to a decrease in body dissatisfaction, 2) a correlation would exist between the effect of the OBI and the change in body dissatisfaction and 3) that the level of experienced embodiment would moderate the change in body dissatisfaction after the OBI was induced. The results of a quantitative analysis suggest a certain trend toward significance in the effect of the OBI task on the decrease of body dissatisfaction. There appears to be no correlation between the effect of the illusion and a change in body dissatisfaction. Furthermore, no proof was found that the level of experienced embodiment moderates the change in body dissatisfaction. Therefore, the data only partially (and cautiously) support the hypotheses.

A certain trend towards significance was found for the effect of the OBI task on change in body dissatisfaction, implying that the OBI task impacted the way the participants felt about their body. The fact that the effect is trending towards significance rather than being truly significant can perhaps be explained by the sample size: a smaller size makes it harder to detect a true effect.

Another possible explanation of why only a trend towards significance and not a significant effect was found, can perhaps be found in the study of Lantz et al. (2018). They describe how patients with AN often hold extremely thin ideals of beauty. Consequently, this begs the question if when they indeed see their thin frames in the OBI experiment, whether this is thin enough to fit their ideals of beauty and thus lowers their feelings of body dissatisfaction. The second hypothesis was not confirmed by the data: no correlation was found between the effect of the OBI and the change in body dissatisfaction. The question that arises is what causes the trend towards significance in decreasing body dissatisfaction, if not for the effect of the OBI? It may be that a surprise effect caused the change in body dissatisfaction, where just looking at oneself from a different perspective may cause a

momentary surprise. In AN, it is often seen that patients tend to zoom in on parts of their body that cause them distress (Freeman, Touyz, Sara, Rennie, Gordon & Beumont, 1991; Jansen, Nederkoorn, & Mulken, 2005). Seeing the whole picture rather than zooming in, even just momentarily, might allow them to look at themselves differently and change their levels of body dissatisfaction.

However, no real conclusions can be drawn about this lack of effect of the OBI for the questionnaire that was used to measure the effect of the OBI, the EQ, was designed specifically for this study and has not been validated yet. As it has not been validated, we can not be sure that the effect of the OBI is truly measured by the questionnaire. Therefore, it can not be ruled out that the effect of the OBI is the cause of the change in body dissatisfaction. Future research should aim to validate the EQ, so as to be positive that the effect of the OBI is actually captured by it. For now, the effect of the OBI as a possible cause for change can not be ruled out. This might apply to the third hypothesis as well, in which we stated that the amount of embodiment would moderate the change in body dissatisfaction after the OBI was induced, which was also measured by the questions of the EQ.

The third hypothesis was not supported either. This is interesting because the opposite effect would be expected, as both Haggard & Jundi (2009) and Lenggenhager et al. (2007) suggest in their studies that embodiment is crucial for the illusion to be effective. However, this unexpected finding is in line with the study of Keizer et al. (2016) in which they also showed that there seemed to be no connection between the levels of embodiment and the effect of illusion on virtual body size estimation. The same results were also found in the study of Holmes, Snijders, & Spence (2006). A study that might make more sense of the lack of consensus on whether embodiment is needed while implementing bodily illusions is the study of Rohde, Di Luca, & Ernst (2011). They argue that perhaps two different mechanisms are at play: proprioceptive drift which signifies the displacement of the perceived location of a body (part) to a fake or illusory body (part), and the feeling of ownership which entails feeling like the illusory body (part) belongs to you. They argue that these terms are used interchangeably when measuring embodiment yet they might not be the same thing. If it is true that two different mechanisms are measured interchangeably, this might explain the lack of consensus on the role of embodiment in bodily illusions and clear definitions on what to measure are warranted.

Limitations and suggestions for future research

The current study is the first of its kind. A certain trend towards significance was found for the first hypothesis. However, the sample size of current study was small, which

makes it difficult to draw conclusions about effects. In addition to that, the group of patients with AN is remarkably heterogeneous, which limits the generalisability of the study (Swift & Stern, 1982; Vitousek & Manke, 1994). The eating disorders of patients that are in treatment at Rintveld are quite often very severe. This too asks for the expansion of the sample, as to improve the external validity. This can be achieved by also recruiting participants at, for example, general practitioners' offices and general mental health organisations. To conclude, future research should aim to address the current limitations with recruiting larger samples that translate better to the population.

Another important factor to consider when interpreting the results of this study, especially in case of the second and third hypotheses, is the validity of the measures. In particular, the EQ used in this study is constructed based on a validated questionnaire by Ehrsonn (2007). However, even though a reliability test was performed, the newly constructed questionnaire was not validated. It is therefore unknown whether the subscales measure what we aimed to measure: the effect of the illusion and the feeling of embodiment. Consequently, interpretation of the results can be difficult and one should be wary with drawing conclusions. Therefore, future research should preferably focus on validating the newly constructed questionnaire by means of a factor analysis.

Finally, another noticeable aspect was that in the current study, the data of one participant who had a comorbid borderline personality disorder (BPD) was very different from the other participants. During the experiment, she reacted very strongly, she was very emotional and described herself as feeling 'gutted'. For this reason, perhaps the diagnosis BPD must in the future be considered an exclusion criteria. On the other hand, this patient was not the only participant diagnosed with BPD. It might be quite difficult to create a standard profile of whom to include and whom to exclude, based purely off of diagnoses. The clinicians that helped in the recruitment of the patients, however, seemed to be able to quite accurately predict which patients would react in a negative manner to the experiment. Clinical judgement of whom to include in the study therefore might be more important than simply filtering on diagnoses.

Clinical implications

In our study results were found that implied that the OBI task seems to be able to decrease feelings of body dissatisfaction in AN. Even though the results are to be interpreted with caution due to the small sample size, for clinical practise these findings may imply that patients suffering from AN may benefit from being subjected to the OBI task. The clinical possibilities of the task are worth exploring in future research.

A question that would be interesting to answer when creating the bridge between research and clinical practice is whether one session of the OBI task is enough to produce a lasting effect. As body dissatisfaction is a core aspect of AN and as the participants in this study were recruited from a highly specialised mental healthcare organisation implying high complexity and severity of the eating disorders, it might be a little too optimistic to expect significant change as quickly as with one session. A study concerning mirror exposure and its effect on body dissatisfaction in AN showed that through multiple sessions systematic desensitization to the image of their bodies occurred, decreasing the amount of body dissatisfaction (Key et al., 2002). This begs the question whether this might also apply to the OBI experiment: perhaps multiple sessions of the OBI experiment will prove to be more fruitful.

However, when looking for possibilities to implement these findings into the clinical practice, caution is warranted: the study of Lantz et al. (2018) mentions that patients with AN often hold extremely thin ideals of beauty. If it is the case that the OBI task does offer the patients a realistic view of their bodies, this can be a point of concern with underweight patients. Seeing their thin frames might cause a desire to maintain this body size, which may interfere with recovery of both weight and the eating disorder. Therefore it may be preferable to not expose those patients with a very low weight to the OBI task, but rather those patients who are closer to a healthy weight.

Conclusion

The results of this first exploratory study are hopeful: they imply that body dissatisfaction can be decreased with the OBI task. As it is the first study that explores the effect of the OBI on body dissatisfaction in AN, there is much room to improve and explore. Current study offers a good starting point and new directions to a better understanding of body image distortions and of how tasks rooted in experimental psychology might aid in reducing those distortions. Given that these body image distortions are a core element in AN resulting in higher relapse rates, this is crucial.

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