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Virtual Reality and Body Dissatisfaction Across the Eating Disorder's Spectrum

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1. Introduction

Body image dissatisfaction is very prevalent in women of all ages [1, 2]. Very early in life, girls are incited to pay attention to their hair, skin, or weight and to what they wear [3]. They learn that they can get praised for their body and appearance and that they have to watch their weight and shape in order not to become overweight [3, 4]. Girls and women are continuously exposed to displays of appearance and can put a significant amount of money, time, and effort in trying to achieve inaccessible beauty standards [5]. In some women, internalization of beauty norms can be so pervasive that they base their success and self-worth almost exclusively on their weight and shape.

Given the prevalence of body dissatisfactions and their consequences on the psychological functioning of women, assessment and treatment considerations must be pursued. Virtual reality represents an interesting way of enhancing motivation to work on body image. Over the years, a growing number of studies have highlighted the effectiveness of virtual reality for reducing body image disturbances in samples of women with eating disorders.

2. The concept of Body Image

Body Image (BI) is a multidimensional concept which includes cognitive, affective, behavioral, and perceptive components [6, 7]. It can also be conceived as a mental picture of the body [8]. The concept of BI implies two basic elements: investment and evaluation. While investment focuses on how important one's appearance can be, evaluation involves appearance appraisals [9, 10]. Evaluation gives rise to satisfaction or dissatisfaction with the body. Subjective satisfaction-dissatisfaction refers to a person's appreciation of his or her body (weight, shape, specific body sites). Body dissatisfaction is more frequently studied than body satisfaction. To be considered dissatisfied with one's body, an individual has to

be seeking different body characteristics than its own, and must report negative thoughts and affects related to a discrepancy between his idealized and actual body [7, 11].

BI is subjective and can change over time, in response to new information or to situational and emotional factors [11, 12]. It develops through cultural socialization, interpersonal experiences, personality factors, physical characteristics, as well as physical changes [10]. Cultures convey information and standards regarding appearance [10]. Such standards are disseminated through media and advertisement. Cultural messages promote stereotypes and inaccessible beauty norms [13]. They dictate what physical characteristics are valued or not valued by people [10]. They also put a strong emphasis on means to achieve a body that better conforms to the beauty standards in vogue, such as dieting, exercising, or using beauty products. In addition to media exposure, family members, peers, and even strangers can exert a pressure to be thin and to meet social standards. While interacting with others, one is confronted to their opinions, expectations, comments, and potentially to their criticisms [10]. Weight loss is particularly encouraged and thinness is reinforced through compliments, approval manifestations, or one's own feelings of self-control or will power [14].

When they comment on their child's body or weight, and when they impose particular food rules in their household, parents are influencing their child's BI in a direct way. They can also have an indirect influence, especially through their own weight and shape preoccupations and through problematic eating behaviors aimed at loosing or controlling their weight [5]. Siblings can represent a source of social comparison and can also contribute to a child's negative self-appraisal [10]. Peer influence is particularly relevant as children move towards adolescence. Adolescent girls tend to report similar levels of body satisfaction/dissatisfaction and dietary restraint to those of their group of friends [5]. Peer influence includes weight and shape comments, appearance teasing, modeling of weight preoccupations and weight control behaviors, establishment of appearance and weight norms, and conversations about weight and shape [5]. In childhood and adolescence, BI evaluation can be closely linked to peer acceptance with regards to one's body and appearance [5, 10].

Physical and personality characteristics are important in BI development [10]. Women and girls who are overweight are more likely to be dissatisfied with their body and to try means of weight control [15, 16]. In fact, the more a woman's weight differs from what she believes to be the ideal weight, the more she is at risk of reporting elevated levels of body dissatisfaction [17]. As stated by Cash [10], how closely one's appearance conforms to cultural standards is essential in self-evaluation. Moreover, personality traits like perfectionism, public self-consciousness, and conformism can predispose an individual to put a strong emphasis on appearance, to internalize beauty standards, and to actively try to attain these standards [10, 18].

3. Body Image in women

Body shape and weight dissatisfactions are so widespread in the general population that they are collectively termed "normative discontent" [5, 19]. Physical appearance plays a critical role in women's gender identity. Women are significantly more vulnerable to social

influences and they report higher body dissatisfaction than their male counterparts [20, 21]. Body image disturbances are so frequent in women that up to 80% of college women report some degree of body dissatisfaction [22]. According to the sociocultural perspective, in women, media exposure leads to internalization and social comparison with regards to appearance, which in turn increases body dissatisfaction and the likelihood of adopting problematic eating behaviors [5]. Body dissatisfaction and problematic eating are related through two possible pathways [23, 24]. The first possible pathway is one through which a negative evaluation of one's weight or body brings about dieting behaviors aimed at weight control or weight reduction. The second pathway pertains to depressive mood. It postulates that negative self-appraisal provokes depressive symptoms and intense feelings, which are regulated through overeating.

Once in place, problematic eating behaviors can lead to the development of an Eating Disorder (ED). Therefore, not only do body and weight dissatisfactions predict problematic eating, but they are also strong predictors of ED onset [25, 26]. In ED, the two basic elements of BI are present: first, the body (weight and shape) is intensively, almost exclusively invested, and secondly, over-evaluation is constantly observed [27]. In fact, in ED patients, body dissatisfaction transforms into over-evaluation of shape and weight. These patients' self-worth relies almost entirely on their shape and weight and even on their ability to control them [19]. Over-evaluation is believed to be the core psychopathology of ED. It affects socialization of ED patients and is manifested in many ways such as checking, scrutinizing, and behaviors of avoidance and comparison. It has a major impact on eating habits, with dietary restraint most likely playing a prominent role [19].

4. Virtual environment for assessing and treating Body Image in ED women

To this day, experimentation with Virtual Reality (VR) has been mainly done with samples of women with ED. Researchers started to use VR in the late 1990s with ED women in order to assess and treat their body dissatisfaction [12]. Riva's team in Italy and Perpiña's team in Spain both developed software packages aimed at assessing body image disturbances [28-30]. Both research teams used their software in treatment contexts, in order to measure changes in body dissatisfaction once treatment was completed.

Many types of virtual environments exist for evaluating and treating BI in ED. All of them share the basic goal of confronting ED women to their fears about weight and shape and to their dysfunctional mental representations of themselves [30]. VR appears particularly effective in treating misperceptions about one's body [31]. Through VR, it is possible to integrate new information about one's body and to acquire ways to differentiate the cognitive and affective perception from the real body. To achieve such distinction, a clinician can, for example, ask a woman who considers herself too big or too fat to use her virtual body to pass through a narrow door or a virtual space that looks too small to her. When she realizes she can pass through the narrow door, it creates an important doubt in her mind about the realism of her perception [32]. As a consequence, she becomes more

likely to admit that her mental representation of her body is distorted, and to develop a new, more realistic and less distressing view of her body. VR allows for a complete BI experience, covering cognitive, behavioral, emotional, and perceptive components of BI [30].

Riva and his team were the first researchers to incorporate VR in the treatment of body image disturbances [33]. Their work was first applied to nonclinical samples, and since their results proved to be encouraging, they conducted the same treatment on samples of patients with ED. Their treatment program is based on what they refer to as Experiential Cognitive Treatment (ECT) [31, 34-36], which aims at challenging and changing ED women's perceptions toward their bodies. More precisely, the goal of the ECT program is to integrate VR as a way of challenging the idea that what looks like a perception (i.e. overweight shape) may in fact just be an assumption. To achieve this goal, they use the Virtual Environment for Body Image Modification 2 (VEBIM 2), which is an enhanced version of the original VEBIM, previously used with nonclinical samples. The VEBIM 2 is composed of five different zones that each correspond to a treatment component. In the first session (zone 1), participants explore the environment and learn how to use VR materials. They are then asked to weigh themselves on a virtual scale in order to focus their attention on the scale and elicit the importance of the weight dimension in the rest of the experimentation. The next zone, used in session 2, is composed of a kitchen, a closet, and a bedroom that each contain different food and drink. Subjects are encouraged to virtually consume what they would normally eat and drink. They do so by selecting the desired virtual stimuli. Once the food is "eaten", the matching calorie intake is computed in order to calculate the total calories ingested. This was created as a way to record the eating habits of the participants and to assess their reactions at the end of the session when confronted with their new weight on the virtual scale. In session 3, participants are immersed in a virtual environment in which they must choose two out of seven figures representing different body types, ranging from underweight to overweight. The two chosen figures represent their perception of their current body size and their ideal body. The discrepancy between the two figures is used as an indication of their level of body dissatisfaction. Session 4 represents a workplace environment in which participants must select food and drink as in session 2. This allows for the establishment of differences in eating behaviors while in the workplace rather than at home. In the fifth and final setting (zone 5), subjects are first immersed in an environment where pictures of models are painted across the room. This is done to elicit emotions that are then analysed by the clinician. Afterwards, the subjects are placed in front of a large mirror and then guided in a room with five doors of different dimensions. To exit this room, they must choose the door corresponding exactly to their width and height [37].

Perpiñá and his team used their own VR software exclusively with ED patients [38]. The VR part of their treatment program consisted of six different settings, including the training room, the kitchen, the poster room, the two-mirrored room, and the six-mirrored [12, 30]. They added 3D human images that can be altered to their software. This enables the participants to model their subjective and desired body, as well as the body shape they envisioned a significant person would have of them.

5. Efficacy of Virtual Reality focusing on Body Image in ED women

In their literature review, Ferrer-Garcia and Guitierrez-Maldonado [12] provide detailed explanations about the suitability of VR in the assessment and treatment of BI. They also provide an extensive list of the studies that have focused on the effectiveness of VR as an addition to the traditional treatment of body image disturbances, both in non-clinical and ED samples. They conclude that VR improves body image disturbances in both types of samples and that this improvement is maintained, even accentuated, at 6-month follow-up [12].

Research to date is mostly limited to the works of Riva's and Perpiñá's teams. Riva and his colleagues [31, 39] found that, in ED patients, a treatement including VR and ECT reduces binge eating, anxiety, and preoccupations having to do with being judged by others. It also improves body satisfaction, self-acceptance, self-esteem, self-efficacy, social functioning, as well as motivation to change. Perpiñá's team [30] also found that the addition of a VR component to a Cognitive-Behavioral Therapy increases its efficacy. ED patients who received the combined treatment condition showed better adherence to treatment, enhanced body satisfaction, decreased negative thoughts and attitudes towards their body, less intensive fears of weight gain following a meal, and a positive change in their beliefs concerning healthy weight.

Past research also shows that virtual stimuli can generate strong emotional responses such as anxiety or depressive symptoms in ED patients. For example, Gorini, Griez, Petrova and Riva [40] found that, for ED patients, virtual food was as anxiety provoking as real food and more so than pictures of food. Others have demonstrated that virtual environments involving high-caloric food elicit strong emotional responses in ED patients [41], reflecting a fear of gaining weight and an over-evaluation of weight and shape. ED patients also report higher anxiety and depressive symptoms in virtual environments where they virtually eat high-energy food [42]. Another significant environment for ED patients is the swimming pool environment. [41, 42]. According to Thompson and Chad [43], the high emotional reaction observed in the pool environment also reflects the over-evaluation of weight and shape in ED women. Additionally, it could be related to the tendency of ED patients to avoid situations in which they have to expose their bodies to other's evaluation, or in which they might compare themselves negatively to others.

6. Virtual Reality in women without ED

Few studies have used VR in women without ED (see Ferrer-Garcia & Guitierrez-Maldonado, 2011 for a review) [12]. Riva's research team showed that women without ED who were exposed to their VEBIM reported a significant decrease in body dissatisfaction following a VR session of 8 to 10 minutes [28, 29, 34, 35]. Such results indicate that VR represents an easy to use and time efficient prevention tool.

Scarce past research has also shown that body dissatisfaction might not be manipulated or treated exactly the same way across the eating disorder spectrum. The type of virtual

environment could differ according to the intensity of weight and shape concerns. For example, Ferrer-Garcia and colleagues [42] found that, in participants without ED, a swimming pool environment is more anxiety provoking than any other virtual environment they used (high and low-calorie kitchen, high and low-calorie restaurant). In fact, the anxiety level of women without ED in the other four virtual environments was equivalent to that of the neutral environment.

Since the eating disorder's spectrum cannot be strictly confined to women with or without ED, our research team decided to evaluate the emotional reactivity of women preoccupied with their weight and shape who did not encounter the diagnosis criteria of ED [44]. In our experiment, we compared the emotional responsiveness of women with subclinical eating, weight, and shape concerns to that of a control group of women whose concerns were within the norms for women without ED [45]. Three virtual environments were used: an office, a swimming pool, and a buffet-style restaurant containing high and low-calorie food. Our results suggest that VR has the potential to generate substantial emotional responses across the eating disorder spectrum and that it could be useful as a prevention tool with individuals at risk of developing ED, or as a way to improve acceptance of one's own body in anyone who reports some body dissatisfaction.

In the subclinical group of our experiment [44], the anxiety level was significantly higher than in the control group during and after exposure to the challenging environments (swimming pool and restaurant), suggesting that women with eating, weight, and shape preoccupations share a tendency with ED women to be more strongly emotionally and cognitively activated by exposure to food (restaurant) and to other women (swimming pool), than women with normative weight and shape concerns. Therefore, as a woman's weight and shape concerns progress through the eating disorder spectrum, she becomes more likely to react to high-calorie food and social comparison.

Moreover, we found that for both groups of women, the swimming pool environment is significantly more effective in eliciting anxiety than the restaurant environment. This latest result is particularly interesting in light of the "normative" dissatisfaction so widely spread in our Western Society. It shows that, no matter the intensity of the eating, weight, and shape preoccupations, and no matter the positioning on the eating disorder spectrum, women are at risk of feeling anxious when they are in an environment where they must expose their body to others' evaluation, and where they have an opportunity to compare themselves to other women. The swimming pool environment has an interpersonal connotation other environments such as the restaurant do not have. It combines two kinds of social influences; the mass media pressure, in which women are exposed to unwanted slim beauty images, and the peer pressure, in which they have to tolerate the evaluation of average women. Since the buffet immersion was not as anxiety provoking as the swimming pool immersion in women with subclinical preoccupations with weight and shape, we believe social comparison might be more relevant than food exposure in women without ED.

7. Social comparison in VR

Social comparison appears to be a promising avenue to explore in VR, since every human being is using social comparison in order to assess their value and standing in life [45]. It has been recognized as an important component of ED treatment and is considered to be a form of shape checking that maintains the over-evaluation of weight and shape in ED patients [19]. ED patients tend to compare themselves to people of the same gender and age (or younger) who are thin and good-looking, and they fail to notice people who are not as good-looking or thin [19].

The Social Comparison Theory [45] offers an interesting framework to understand the increased emotional reactivity and potential body dissatisfaction following VR. This theory postulates that both intentional and unintentional comparisons with others are a common and basic phenomenon in humans [22]. Depending on its direction (upward or downward), social comparison has different affective consequences. When a woman compares herself to someone who appears to better meet beauty standards (upward comparison), she is more likely to experience deleterious effects from her comparison, such as feelings of discontent and dissatisfaction. However, positive emotional effects may occur when a woman compares herself to someone whose weight and appearance appear worse than her own weight and shape (downward comparison). VR can provide, in a controlled setting, standards against which women with different BI could compare themselves to other women or even to beauty icons. In VR, the characteristics of the comparison target can be manipulated in such ways to facilitate either upward or downward comparisons and to evaluate their affective consequences.

In order to test the social comparison theory, our research team [46] recently created a bar environment in which social comparison with a waitress was induced (Figure 1). Two different types of stimuli were used: an overweight (Figure 2) and a thin virtual waitress. Two very different body types were chosen as virtual humans as a way of not only inducing social comparison, but also of assessing the type of comparison prompted, whether it be upward or downward. Additionally, the bar environment included two virtual males sitting at a table, commenting on the waitress' appearance. This component was added as a way of further guiding the participants' attention towards the waitress and therefore facilitating the comparison process.

Before the immersions, participants were told to enter the bar with the intention of waiting for a friend that was supposed to meet them there. They were asked to pay attention to the waitress since she would inform them of the arrival of their friend. Once in the environment, participants were asked to take a few minutes to walk around the bar and then wait for their friend at the counter near the waitress. Once in position, the animation was activated and the male customers proceeded to comment on the waitress, their comments being adapted to each waitress. For instance, the thin waitress received more positive comments on her appearance, whereas the overweight waitress' appearance was commented on in a more negative light.

Body dissatisfied women were reporting even less satisfied feelings with their general appearance after being exposed to both types of virtual humans. This was particularly true for those who were first exposed to the overweight and then to the thin waitress. Therefore, exposure to a thin virtual human following an exposure to an overweight virtual waitress was associated with less satisfaction with one's appearance. These results partly support Festinger's theory of social comparison [45] and show that the order of exposure to virtual humans can modulate women's reaction. They suggest that a greater gap in the comparison is created when body dissatisfied women are first exposed to an overweight virtual human and then to a thin one. Social comparison could be exacerbated as participants went from an upward comparison to a downward comparison, subsequently creating a stronger reaction.

Although results obtained in our preliminary study weren't conclusive on all measures, these early findings do in fact concur with the idea that social comparison may play an important role in body dissatisfaction. Furthermore, it suggests that social comparison may be transposed to the virtual world. Findings like these are quite encouraging, and suggest that VR is a tool that offers a great alternative to traditional treatment programs used with body dissatisfied women.

Figure 1. Virtual bar environment

Figure 2. Overweight waitress virtual human

8. Conclusion and future directions in VR and BI

RV can be used in order to assess and treat body dissatisfaction across the spectrum of ED. It compares to real life situations in terms of its capacity to induce anxiety feelings and is often preferred over *in vivo* exposure. RV permits social interaction as well as social comparison in women with different levels of weight and shape preoccupations. While using VR, it seems possible to challenge the "normative discontent" view and better identify which characteristics lead to increased body dissatisfaction in certain people and not in others. Considering that, in our experiments, women without weight and shape preoccupations did not react as strongly as body dissatisfied women when immersed in a social comparison context, it seems that not "all" women similarly suffer from upward comparison.

Up to this day, in women with or without ED, VR has exclusively been used in treatement as an adjunct to cognitive-behavioral therapy. It has proved to be an effective tool that allows for exposure, desensitisation as well as cognitive retraining [47, 48]. Since it improves BI and body satisfaction when used in combination with cognitive-behavioral therapy [30, 39], some researchers have argued that VR should not be limited to this therapeutic approach but could also be considered beneficial in other types of psychotherapy, such as the interpersonal therapy or the psychodynamic therapy [33, 47, 48]. Given that VR is an experiential form of imagery that can induce emotions similar to those present in real life settings [47], it seems especially appropriate to use it in psychodynamic therapy. In fact, RV can facilitate the evocation and expression of emotions that would not necessarily be activated in a regular therapy setting (for example in the therapist's office), which in turn, increases the degree of closeness between the client and the therapist [47] and contributes positively to their relationship, an important focus in psychodynamic therapy. Moreover, VR provides a safe environment for eliciting and working on emotions in such a way that a corrective emotional experience becommes possible. Virtual humans can also represent an interesting tool to give access to repressed material [33] and to facilitate transference as well as resolution of past conflicts in clients [48, 49].

When considering future research in VR and BI, some drawbacks of the existing studies must be considered. Firstly, as others have pointed out, few controlled studies assessing the effectiveness of VR in body image disturbances have been conducted [12]. This is particularly true for samples of non-ED participants. Secondly, the ability of different virtual environments to evoke emotional reactivity in different types of participants across the eating disorder spectrum has to be evaluated, with new environments being tested and social comparison being considered. Thirdly, most studies using VR, including our own, used small samples of participants consisting almost exclusively of women. Fourthly, when studying treatment, follow-up results must also be obtained.

At a clinical level, psychotherapists interested in using VR to treat body dissatisfactions in women have to be aware of some possible adverse effects of VR with such clientele. First of all, VR in BI and other disorders has been linked to some side effects that can be classified in three types of symptoms: ocular problems (ocular fatigue, eye-strain, and blurred vision), disorientation, and nausea [50]. Clinicians must also be conscious that simple exposure to

images of beauty models can increase body dissatisfactions in women. Therefore, they have to make sure their women clients will have time to discuss this possible increase in body dissatisfactions with them and they must set aside time to re-evaluate and counter the appropriateness of their perceptions about their BI. Clinicians should also assess the general psychopathology of their clients before using RV with dissatisfied or ED women. This seems particularly important considering that, in some women, dissociative episodes could be experienced as a consequence of a strong emotional response that cannot be tolerated by the client. Although, in most clients, the evocation of emotions is desirable and can accentuate their motivation to change, for those having a psychological disorder which can give rise to dissociative or even decompensating episodes, VR should be dosed accordingly to the results of the evaluation and to the diagnosis of their client.

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