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Eating Disorders Psychiatry

# Digital interventions and eating disorders: a state-of-the-art review

## VIRTUAL REALITY

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*General Adult Psychiatrist*

RCPsych Faculty of Eating Disorders Psychiatry
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- Eating disorders
- Risks and benefits of digital
- Virtual reality
- m-Health
- Directions for future research
- Conclusions

Eating disorders (EDs) are serious mental health disorders that cause impairments in physical health, development, cognition and psychosocial function and can go undetected for months or years.

Treasure J, 2015

With DSM-5's reclassification of EDs in 2013 the criteria needed to make a diagnosis of **anorexia nervosa** (AN) and **bulimia nervosa** (BN) have been broadened and new diagnoses such as **binge eating disorder** (BED), night eating syndrome, purging disorder and avoidant-restrictive food intake disorder (ARFID) included.

The lifetime prevalence of **AN** in female is ranged from 1.7% to 3.6%, with a peak age of onset of 13 to 18 years.
AN has a mortality rate of at least 5 to 6%, the highest mortality rate of any psychiatric illness.

The Lifetime prevalence of **BN** is between 0.9% and 3% with an older age of onset of 16 to 17 years.
Although mortality rates in BN are estimated to be ~2%, the risk of lifetime suicidality and suicide attempts in BN are much higher.

The lifetime prevalence estimates for **BED** is between 0.8%-1.9%. Median age of onset is in the late teens to early 20s, similar but slightly older than for BN.

Dahlgren CL, 2017

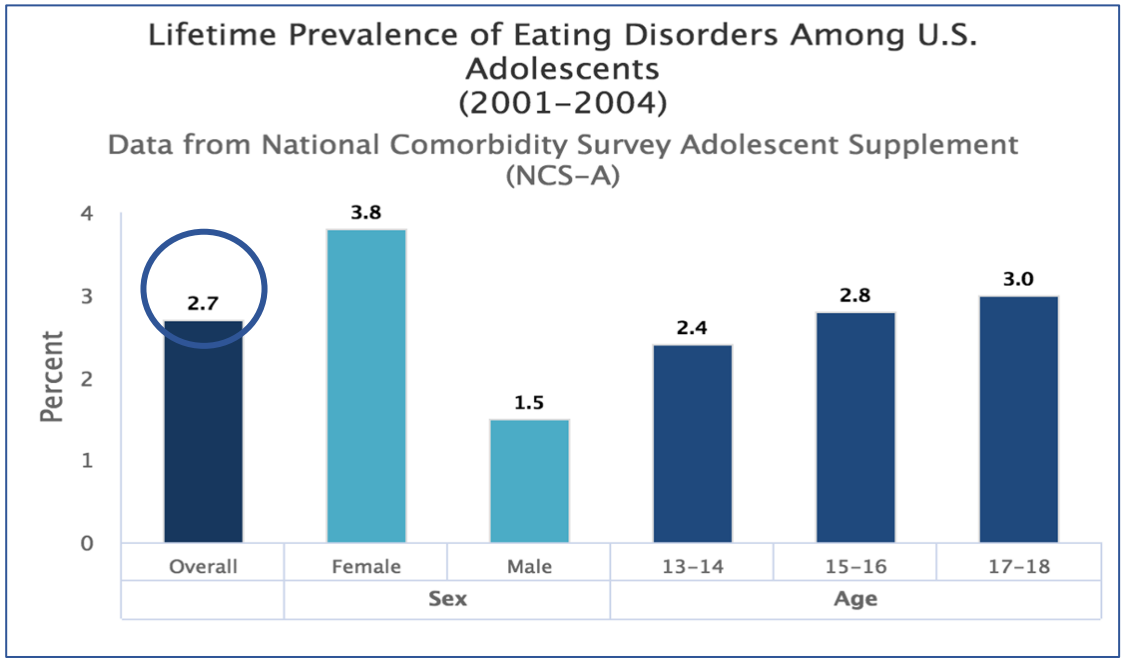


**Table 1. Sex-Specific Lifetime and 12-Month Prevalences and 12-Month to Lifetime Prevalence Ratios of Eating Disorder Subtypes Among 10 123 Adolescents**

| | % (SE) | | | | |
|---|---|---|---|---|---|
| Prevalence or Ratio | AN | BN | BED | SAN[a] | SBED |
| Lifetime prevalence | | | | | |
| Total | 0.3 (0.06) | 0.9 (0.16) | 1.6 (0.22) | 0.8 (0.09) | 2.5 (0.26) |
| Male | 0.3 (0.09) | 0.5 (0.19) | 0.6 (0.19) | 0.1 (0.04) | 2.6 (0.41) |
| Female | 0.3 (0.10) | 1.3 (0.22) | 2.3 (0.40) | 1.5 (0.20) | 2.3 (0.36) |
| 12-mo prevalence | | | | | |
| Total | 0.2 (0.05) | 0.6 (0.15) | 0.9 (0.16) | NA | 1.1 (0.12) |
| Male | 0.2 (0.08) | 0.3 (0.22) | 0.4 (0.09) | NA | 1.0 (0.17) |
| Female | 0.1 (0.06) | 0.9 (0.17) | 1.4 (0.33) | NA | 1.2 (0.22) |
| Ratio of 12-mo to lifetime prevalence | | | | | |
| Total | 57.9 (11.32) | 72.0 (8.50) | 56.0 (5.81) | NA | 44.5 (3.64) |
| Male | 69.9 (15.54) | 73.7 (19.89) | 43.3 (9.86) | NA | 38.0 (5.40) |
| Female | 46.7 (12.05) | 71.3 (8.04) | 60.9 (6.85) | NA | 52.4 (6.41) |

Abbreviations: AN, anorexia nervosa; BED, binge-eating disorder; BN, bulimia nervosa; NA, not applicable; SAN, subthreshold AN; SBED, subthreshold BED.
[a] The 12-month prevalence of SAN was not assessed.

Swanson SA, 2011

DSM-5's reclassification of EDs in 2013 means that more young people meet diagnostic criteria for a specific eating disorder than previously.

Estimated lifetime prevalence in the community of clinically significant EDs in **adolescents (13-18)** is around 13%, of which only 0.8–1.7% meet criteria for AN, 0.8–2.6% for BN, BED 2.3–3% and the remainder have subthreshold or atypical EDs.

BED, and subthreshold or atypical cases also appear to be on the increase.

- Younger patients diagnosed with EDs are more likely to be boys, with a female to male ratio of 6 to 1, compared with a 10 to 1 ratio in adults.

Mairs R, 2016

RISKS

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ELSEVIER

JOURNAL OF ADOLESCENT HEALTH

www.jahonline.org

Original article

## #Proana: Pro-Eating Disorder Socialization on Twitter

Alina Arseniev-Koehler [a,b,*], Hedwig Lee, Ph.D. [a], Tyler McCormick, Ph.D. [a,c], and Megan A. Moreno, M.D., M.S.Ed, M.P.H. [b,d]

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*Keywords:* Eating disorders; Pro-eating disorder; Social media; Social networks; Social support; Twitter; Adolescent health

BENEFITS

CYBERPSYCHOLOGY, BEHAVIOR, AND SOCIAL NETWORKING
Volume 23, Number 5, 2020

DOI: 10.1089/cyber.2020.29183.gri

EDITORIAL

## How Cyberpsychology and Virtual Reality Can Help Us to Overcome the Psychological Burden of Coronavirus

Giuseppe Riva, PhD,[1,2] and Brenda K. Wiederhold, PhD, MBA, BCB, BCN[3,4]

Risks connected with the use of online health information

Since the Internet has such a huge potential for dissemination of health information, this goes hand in hand with the potential to spread low-quality, misleading, false, or even harmful information

Media exposure

Social influence

Online groups, as social entities, can affect members' views and acceptance of certain norms, attitudes, perspectives, and practices.

Pro-ED websites

www.myproana.com with a variety of sections and blogs that are pro-ED

Sharing tips and tricks

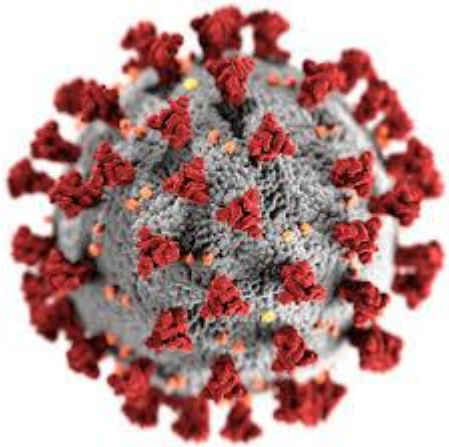
Social comparison

Sharing negative statements

BUT…

There are significant barriers to access to treatments for eating disorders, including stigma, shame, costs, and, over time, EDs become more severe and less responsive.

Interventions using technologies have the potential to reduce these barriers and the spread of e-Health may help to reach a larger population.



There has been a recent and unprecedented demand for telemedicine to facilitate the continuity of care during COVID-19 despite geographical circumstances.

- The aim of this session is to present an overview of digital interventions for EDs treatment.

Virtual reality (VR)

m-Health (mobile technology)

# VIRTUAL REALITY

Virtual reality (VR) can be defined as a computer technology that reproduces a real or imaginary environment and that simulates the user's presence in that physical environment, with which the user can interact through engagement of his or her **senses** (sight, touch, hearing, and smell).

VR has been assessed in mental health conditions

Rehabilitation of patients with schizophrenia

Management of phobic disorders

Treatment of posttraumatic stress disorder symptomatology

VR exposes users to interactive **3-dimensional environments** that simulate a specific situation and, through guided imagination, overcomes the disadvantages of exposure to a real-life situation, including a possible lack of control over participants' thoughts and imaginative difficulties. Exposing patients to VR allows delivery of therapy in a form that they may find more acceptable.

*Psychological Medicine* (2017), **47**, 2393–2400. 
doi:10.1017/S003329171700040X

INVITED REVIEW

# Virtual reality in the assessment, understanding, and treatment of mental health disorders

D. Freeman[1,2]*, S. Reeve[1], A. Robinson[3], A. Ehlers[2,3], D. Clark[2,3], B. Spanlang[4] and M. Slater[4,5]

Description of the potential of VR in mental health, including a consideration of the first 20 years of applications.

A systematic review of empirical studies. 285 studies were identified, with 86 concerning assessment, 45 theory development, and 154 treatment.

The main disorders researched were anxiety (n = 192), schizophrenia (n = 44), substance related disorders (n = 22) and **eating disorders (n = 18).**

The most established finding is that VR exposure-based treatments can reduce anxiety disorders, but there are numerous research and treatment avenues of promise.

We conclude that VR has the potential to transform the assessment, understanding and treatment of mental health problems. The treatment possibilities will only be realized if – with the user experience at the heart of design – the best immersive VR technology is combined with targeted translational interventions.

Eating Disorders

There are a number of obvious mechanistic targets for VR in the treatment of eating disorders

Reducing food cravings

Improving body image

Enhancing emotion regulation skills

A total of **18** empirical studies were identified, 10 concerning treatment, seven assessment, and one theory development. Despite an early use of VR for eating disorders, it has been recognized that the field has very few methodologically strong studies.

Suitable VR environments can bring on food cravings, with responses to VR food comparable with real food.

The preliminary trial evidence is that **VR techniques added to standard CBT help to improve body image.**

In an intriguing VR experimental study, Keizer et al. (2016) helped patients with anorexia nervosa to experience ownership of a healthy body mass index (BMI) body, which led afterwards, for at least 2 h, to a reduction in body size overestimation.

New research on understanding the body ownership illusion in VR is likely to enhance eating disorder treatments.

## 1. Body image

- Body-image disturbances have been frequently and strongly associated with the development and maintenance of eating disorders.

- Hilde Bruch was the first to note that the dysfunctional experience of body image was a central aspect in anorexia nervosa. Some years later, Rosen stated that ‘‘body image disturbance is essentially what distinguishes them [ED] from other psychological conditions that occasionally involve eating abnormalities and weight loss’’.

- Body image disturbances are now regarded as a **key element** in ED and are part of the criteria for diagnosing both anorexia and bulimia.
- Body size overestimation and body dissatisfaction are risk factors for both ED development and relapse.
- Furthermore, research has demonstrated their implications for prognosis, indicating that a persistent dysfunctional body image after treatment is a long term factor in negative outcomes.

Given the importance of body-image disturbances in the onset and maintenance of eating disorders, a great deal of research has been carried out into the relationship between.

The earliest accounts of using virtual reality to positively modify body image were aimed at reducing body dissatisfaction by increasing bodily awareness (e.g., Riva, 1998).

Most recent developments try to stimulate bodily processes in a more integrative way, with the aim of improve body experiences and thus to impact on overall health and well-being (e.g., Riva, Serino, Di Lernia, Pavone, & Dakanalis, 2017).

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Volume 13, Number 5, 2010

DOI: 10.1089/cyber.2009.0301

# Body Image in Eating Disorders: The Influence of Exposure to Virtual-Reality Environments

José Gutiérrez-Maldonado, Ph.D.,[1] Marta Ferrer-García,[1]
Alejandra Caqueo-Urízar, Ph.D.,[2] and Elena Moreno[3]

85 ED patients and 108 non-ED students were randomly exposed to four **experimental virtual environments**: a kitchen with low-calorie food, a kitchen with high-calorie food, a restaurant with low calorie food, and a restaurant with high-calorie food.

In the interval between the presentation of each situation, body-image distortion and body-image dissatisfaction were assessed.

**STABILITY OF BODY-IMAGE DISTURBANCES**

TABLE 1. MEAN AGE, BMI, AND EAT-26 SCORES OF CONTROLS AND THE ED GROUPS

| *Group* | | *Min.* | *Max.* | M | SD |
|---|---|---|---|---|---|
| Control | Age | 20 | 31 | 22.18 | 2.05 |
| | BMI | 18.03 | 25 | 21.77 | 1.82 |
| | EAT-26 | 0 | 18 | 2.98 | 4.11 |
| | $n = 108$ | | | | |
| ED (AN) | Age | 13 | 32 | 19.27 | 5.39 |
| | BMI | 12.76 | 21.83 | 18.22 | 1.75 |
| | EAT-26 | 0 | 68 | 36.24 | 21.57 |
| | $n = 49$ | | | | |
| ED (BN) | Age | 15 | 28 | 20.50 | 2.33 |
| | BMI | 18.58 | 31.95 | 23.00 | 3.19 |
| | EAT-26 | 2 | 71 | 23.64 | 22.15 |
| | $n = 22$ | | | | |
| ED (EDNOS) | Age | 13 | 21 | 15.93 | 1.97 |
| | BMI | 18.03 | 35.85 | 20.89 | 4.45 |
| | EAT-26 | 9 | 70 | 49.14 | 14.76 |
| | $n = 14$ | | | | |
| Total ED | Age | 13 | 32 | 19.04 | 4.82 |
| | BMI | 12.76 | 35.85 | 19.9 | 3.41 |
| | EAT-26 | 0 | 71 | 35.11 | 22.14 |
| | $n = 85$ | | | | |

ED, eating disorders; AN, anorexia nervosa; BN, bulimia nervosa; EDNOS, eating disorder not otherwise specified; BMI, body mass index; EAT-26, Eating Attitudes Test-26.

Several repeated measures analyses of variance showed that ED participants had significantly higher levels of body-image distortion and body dissatisfaction after eating high-calorie food than after eating low-calorie food, while control participants reported a similar body image in all situations.

The results suggest that body-image distortion and body-image dissatisfaction show both trait and state features.

On the one hand, ED patients show a general predisposition to overestimate their body size and to feel more dissatisfied with their body image than controls.

On the other hand, these body-image disturbances fluctuate when participants are exposed to virtual situations that are emotionally relevant for them.

## 2. Exposure to food stimuli

Gorini *et al. Annals of General Psychiatry* 2010, **9**:30
http://www.annals-general-psychiatry.com/content/9/1/30

ANNALS OF GENERAL PSYCHIATRY

PRIMARY RESEARCH Open Access

### Assessment of the emotional responses produced by exposure to real food, virtual food and photographs of food in patients affected by eating disorders

Alessandra Gorini*[1], Eric Griez[2], Anna Petrova[3] and Giuseppe Riva[1,4]

To test whether virtual stimuli are as effective as real stimuli, and more effective than photographs in the anxiety induction process, we tested the emotional reactions to real food (RF), virtual reality (VR) food and photographs (PH) of food in two samples of patients affected, respectively, by anorexia (AN) and bulimia nervosa (BN) compared to a group of healthy subjects.

The two main hypotheses were the following:

(a) the virtual exposure elicits emotional responses comparable to those produced by the real exposure;

(b) the sense of presence induced by the VR immersion makes the virtual experience more ecological, and consequently more effective than static pictures in producing emotional responses in humans.

→ 10 AN, 10 BN and 10 healthy control subjects (CTR) were randomly exposed to three experimental conditions: RF, PH, and VR while their psychological (Stait Anxiety Inventory (STAI-S) and visual analogue scale for anxiety (VAS-A)) and physiological (heart rate, respiration rate, and skin conductance) responses were recorded.

RF and VR induced a comparable emotional reaction in patients higher than the one elicited by the PH condition. We also found a significant effect in the subjects' degree of presence experienced in the VR condition about their level of perceived anxiety (STAI-S and VAS-A): the higher the sense of presence, the stronger the level of anxiety.

The present data show that VR is more effective than PH in eliciting emotional responses similar to those expected in real life situations.

The present study suggests the potential of VR in a variety of experimental, training and clinical contexts, being its range of possibilities extremely wide and customizable.

In particular, in a psychological perspective based on a cognitive behavioral approach, the use of VR enables the provision of specific contexts to help patients to cope with their diseases thanks to an easily controlled stimulation.

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PMCID: PMC5948410
PMID: 29703715

**The Use of Virtual Reality in Patients with Eating Disorders: Systematic Review**

Monitoring Editor: Gunther Eysenbach

Reviewed by Cedric Buche, Qijin Cheng, Kunali Gurditta, and Shanshan Tuo

Damien Clus, MD,[1] Mark Erik Larsen, PhD,[2] Christophe Lemey, MD,[3] and Sofian Berrouiguet, MD[4,5]

Studies that addressed the use of VR techniques in an **eating disorder sample only,** in comparison with either another treatment condition or a control group.

26 studies

The team of Riva et al. produced approximately one-third of the included articles (8/26, 31%).

## Technology Used

- Most of the studies used visual immersive equipment (16/26, 62%) with a head-mounted display (15/16, 94%).
- One study used a cubic immersive room with the projection of a virtual environment on the walls (cave system).
- A total of 7 studies used audio stimuli in combination with visual kinematics to allow user–virtual world interaction and gradual exposure to high-calorie food stimuli associated with chewing sounds or comments on ingested foods.
- Also, only 1 study used visual-tactile stimulation complemented with immersive material, which included an obese patient to test the effect on her assessment of her body measurements.

Two main areas of interest emerged from these studies:

- virtual work on patients' body image (7/26, 27%)
- exposure to virtual food stimuli (10/26, 38%).
- Some study protocols analyzed both of these fields (6/26, 23%).

15 (58%) studies had a primary therapeutic objective.

11 (42%) studies evaluated the users' tolerance of the protocol and their emotional reactions during the VR immersion.

The use of a VR module in addition to CBT showed greater efficacy in the main variables analyzed in comparison with control groups or CBT alone.

Overall, VR techniques enable the evaluation of pathological eating behaviors and body image distortions. In addition to CBT, use of VR techniques by patients with eating disorders decreased their negative emotional responses to virtual food stimuli or exposure to their body shape.

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PMCID: PMC7206518
PMID: 32324145

Bringing Virtual Reality From Clinical Trials to Clinical Practice for the Treatment of Eating Disorders: An Example Using Virtual Reality Cue Exposure Therapy

Monitoring Editor: Gunther Eysenbach

Reviewed by Marie Lippmann and Shelly DeForte

Theresa Brown, MS,[#1] Emily Nauman Vogel, MS,[#1] Sarah Adler, PsyD,[2] Cara Bohon, PhD,[2] Kim Bullock, MD,[2] Katherine Nameth, BS,[2] Giuseppe Riva, PhD,[3,4] Debra L Safer, MD,[#2] and Cristin D Runfola, PhD[#2]

VR offers several promising advantages to in vivo exposure that may result in reduced therapist burden, more rapid symptom improvement, improved acceptance of treatment, reduced treatment dropouts, and more accurate measurement-based care.

- Patients with bulimia nervosa (BN) and BED who remained symptomatic after CBT showed a significantly greater reduction in binge eating and higher percentages of abstinence from binge eating and purging after randomization to six sessions of VR vs six sessions of additional CBT.
- Results from a 6-month follow-up of this same study revealed that reductions in binge, purge, and overeating episodes were greater after treatment with VR-CET [18]. Such results suggest VR-CET is not only efficacious posttreatment but appears to have lasting effects.
- A total of three case reports using a similar non immersive VR-CET program as a complementary tool to CBT demonstrated positive effects with patients diagnosed with restrictive anorexia nervosa (AN-R), binge/purge anorexia nervosa (AN-B/P), and BN.

- The patients' responses to VR outlined in the research above are <u>rapid</u>.
- Faster acting treatments may reduce treatment length and, as a result, reduce clinic wait times—thereby positively addressing access to care issues.
- Given these potential advantages, the authors discuss the importance of pilot testing in real-world clinical settings at this stage in the developmental process.

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behavioral sciences

MDPI

*Review*

# Virtual Reality as a Promising Strategy in the Assessment and Treatment of Bulimia Nervosa and Binge Eating Disorder: A Systematic Review

Marcele Regine de Carvalho [1,2,*], Thiago Rodrigues de Santana Dias [3], Monica Duchesne [3], Antonio Egidio Nardi [2] and Jose Carlos Appolinario [3]

Assessment

Promise in identifying:

(1) how those patients experienced their body image;

(2) environments or specific kinds of foods that may trigger binge–purging cycle. Some studies using

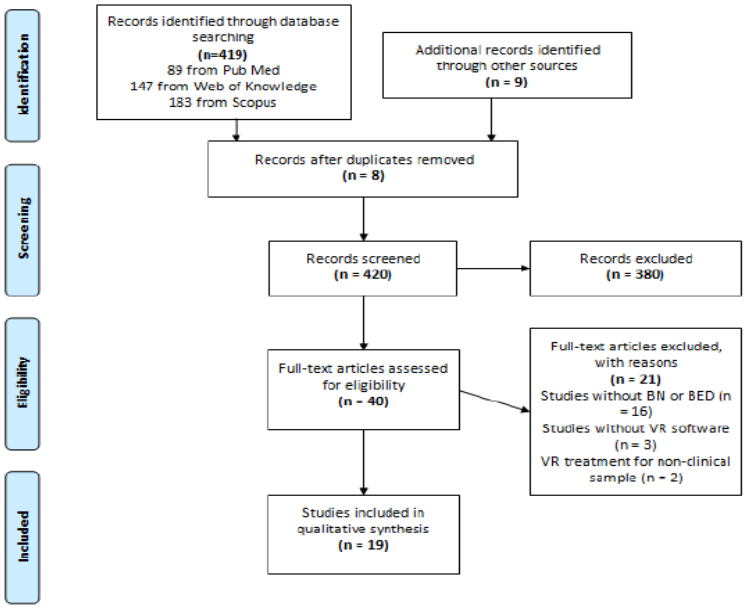


**Figure 1.** PRISMA Flow Diagram.

Treatment

VR technologies associated to cognitive behavioral procedures demonstrate their potential utility in improving eating related (binge-eating, urge to eat, etc.), general psychopathology and other aspects of these binge–purging conditions.


- Marco, J.H.; Perpiñá, C.; Botella, C. Effectiveness of cognitive behavioral therapy supported by virtual reality in the treatment of body image in eating disorders: One year follow-up. Psychiatry Res. **2013**, 209, 619–625.
- Cesa, G.L.; Manzoni, G.M.; Bacchetta, M.; Castelnuovo, G.; Conti, S.; Gaggioli, A.; Mantovani, F.; Molinari, E.; Cardenas-López, G.; Riva, G. Virtual reality for enhancing the cognitive behavioral treatment of obesity with binge eating disorder: Randomized controlled study with one-year follow-up. J. Med. Internet Res. **2013**, 15, 1–13.

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Review article

The use of virtual reality in the study, assessment, and treatment of body image in eating disorders and nonclinical samples: A review of the literature

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Editorial

Virtual Worlds versus Real Body:
Virtual Reality Meets Eating and Weight Disorders

Giuseppe Riva, PhD,[1,2] José Gutiérrez-Maldonado, PhD,[3]
and Brenda K. Wiederhold, PhD, MBA, BCB, BCN[4,5]

Virtual reality technology offers a new resource to study, assess, and treat these disturbances, contributing to increased knowledge and clinical management of body image disturbances.

The groups of Riva (e.g., Riva et al., 2002, 2003; Riva & Melis, 1997) and C Perpiñá (e.g., Perpiñá et al., 1999, 2003, 2004) suggest that the **addition** or combination of virtual reality to other treatments, such as visual motor and cognitive-behavioural therapy, improves body image dissatisfaction.

The research group of Gutiérrez-Maldonado, began by showing the ability of virtual environments to trigger real-life-like emotional responses in patients with eating disorders and controls (Ferrer-García et al., 2009; Gutiérrez-Maldonado et al., 2006), and then successfully used them to study body image in ED (Gutiérrez-Maldonado et al., 2010).

Nevertheless, this review also highlights the need of further research and the use of stronger methods in this field. As Gregg and Tarrier claimed (2007), more controlled studies comparing VR-based therapies and other treatments are needed, using larger samples and providing information about effect sizes.

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Body Image

journal homepage: www.elsevier.com/locate/bodyimage

## Using immersive virtual reality to modify body image

Kamila R. Irvine[a,*], Andrew R. Irvine[b,c], Nadia Maalin[c], Kristofor McCarty[a], Katri K. Cornelissen[a], Martin J. Tovée[a], Piers L. Cornelissen[a]

Both intervention groups experienced statistically significant reductions in their concerns about their own body shape, weight and eating habits.

- VR is increasingly being applied in the evaluation and management of patients with eating disorders, with a recent increase in articles being published.

- Two types of VR interventions is likely in the coming years: the use of VR for altering in real time the experience of the body (embodiment), and VR as a cue exposure tool for reducing food craving.

- Computer generated graphic environments—virtual reality (VR) and augmented reality (AR)—can integrate and extend existing prevention, assessment, and treatment protocols for eating and weight disorders.

- This technology, when accepted by this population, allows patients to be immersed in virtual environments that are adapted to their psychological state.

- Studies showed that VR assessment tools provide novelty features when compared to available psychometric tests.

- Psychometric instruments can collect information through patients reporting, but VR can turn these reports into concrete perceptions. Other advantage is that the perception of presence in the virtual environments can elicit compulsive behaviors in a way like reality, and this is a benefit when studying the triggers of BE and the response to them

- The virtual environment makes it possible to control the unexpected and to be exposed in a safe environment to certain fears that may be difficult to reproduce in real situations, and it affords a greater degree of confidentiality.

- The capability of VR to simulate reality could greatly increase access to psychological therapies, while treatment outcomes could be enhanced by the technology's ability to create new realities. VR may merit the level of attention given to neuroimaging.

- The evidence thus far suggests minimal known risk associated with VR exposure therapy, which may reduce concern for deployment-focused treatment development.

One important risk associated with the utilization of any VR platform includes cybersickness, a side effect that 20% to 80% of VR users may experience. The symptoms of cybersickness are similar to motion sickness and can include nausea, headaches, and dizziness. For most people, cybersickness occurs about 15 min into the VR immersion, is worst in the first session, and becomes negligible by the third session.

In addition, clear procedures to address cybersickness within VR-based exposure protocols can mitigate the risks associated with these unpleasant symptoms and should always be included when implementing VR-based therapies.

VR appears to be a non deleterious treatment for patients with anxiety disorders.

- A clear protocol for VR for EDs will help translate the exciting research supporting the applications of VR into a clinic-ready intervention, providing a model use and, ultimately, a more comprehensive understanding of the full potential of the applications of VR on mental health care globally.

- Future research should take advantage of the unique methods of data collection and assessment available within VR, including the collection of real-time self-reported data in virtuo and biological measurements that can track eye movements, facial gestures, and the movement of body parts.

- Given the large number of stimuli that can be manipulated and tightly controlled within VR environments (eg, intensity of stimuli, contextual, and sensorial cues), basic science research can utilize VR applications to advance the understanding of ED mechanisms of change.

...

...

- Given evidence that integrating VR technology with EBTs for EDs such as CBT leads to significantly improved outcomes, with faster effects and better maintenance than standard treatment alone, following the above recommendations to create and implement a comprehensive VR protocol may help make evidence-based care more accessible and cost-effective for patients with an ED.

- The main limitations of this technology are the insufficient number of therapists trained in its use, side effects such as "simulator sickness", and the high cost of equipment.

**Thank you!**

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