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Research report

Identifying specific cues and contexts related to bingeing behavior for the development of effective virtual environments ☆

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ABSTRACT

Background: Binge eating behavior constitutes a central feature of both bulimia nervosa (BN) and binge eating disorder (BED). Cue exposure therapy (CET) has been proposed as an effective intervention. *Objective:* To determine which situations and specific cues trigger higher levels of binge craving and to use the results in the development of virtual reality scenarios in which CET could be applied with BN and BED patients. *Method:* Participants were 101 outpatients, 50 with BED and 51 with BN, according to DSM-5 criteria, and 63 healthy undergraduate students who completed a self-administered questionnaire to assess binge craving. *Results:* The likelihood of binge craving in the clinical group was greater when alone at home, during the afternoon/early evening and in the late evening/at night, at weekends, and at dinner time or between meals. Higher levels of craving were produced in the kitchen, bedroom, dining room, and bakery situations. With regard to the specific cues reported, the presence of and access to high calorie food and snacks was the most commonly reported cue. Although some gender differences regarding triggering factors were obtained, no statistical differences were observed between ED subtypes. BN and BED patients showed significantly higher levels of binge craving than controls in all the contexts except when feeling positive affect; in this situation, levels of craving were low in both groups. *Conclusions:* This information regarding trigger contexts and specific cues can be used to create valid and reliable virtual environments for CET. Indeed, the data from this study may serve to develop a wide range of situations with different levels of binge craving, in which the therapeutic aim is to extinguish conditioned responses and facilitate the generalization of craving extinction.

Introduction

Binge eating is a highly prevalent and serious core feature of all forms of eating disorders (EDs), and it is also a key behavior in relation to the etiology and severity of obesity (Bulik, Sullivan, & Kendler, 2002). Following the assessment and treatment of people with this type of behavior, some authors have concluded that *food craving* can trigger binge eating behavior (Booth, Lewis, & Blair, 1990; Cepeda-Benito & Gleaves, 2001; Fairburn & Cooper, 1982). As a result, the definition of the concept and the measurement of specific food craving cues have begun to receive attention (Pull, 2004). The conditioning model of binge eating postulates that exposure to certain specific stimuli associated with binge eating (e.g., the presence of high caloric meals) provokes the physiological response known as *craving*. In addition, if bingeing then occurs, the connection between the conditioned stimulus (specific cue) and binge behavior would be strengthened, which in turn would increase the likelihood of the situation recurring in the future (Overduin & Jansen, 1995). *Food craving* is usually

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defined as an appetitive motivational-emotional state that triggers the search for food and the consequent intake behaviors (Cepeda-Benito, Gleaves, Williams, & Erath, 2000) even in a state of satiety. It differs from *hunger*, which refers to the physical need of food after deprivation.

Cue exposure with response prevention of bingeing (ERP-B), a type of treatment derived from this model, involves exposing patients to binge foods and preventing bingeing while the food is touched and smelled. The rationale of this intervention is based on the principles of conditioning and learning. It has been proposed that classical conditioning processes play a major role in the onset and maintenance of bingeing behavior (Jansen, 1998). Thus, the intake of binge food is regarded as the unconditioned stimulus, and all the stimuli associated with this binge behavior are considered the conditioned stimuli. Exposure to conditioned stimuli elicits physiological responses which are subjectively experienced as food craving, and leads to excessive food intake. Thus, the main objective of cue-exposure therapy is to extinguish food craving by breaking the link between the conditioned stimuli and the unconditioned stimulus. Other authors suggest that anticipatory anxiety associated with binge eating cues triggers bulimic hunger; accordingly, the suppression of anxiety reduces the frequency of binge behavior (Martinez-Mallén et al., 2007; Toro et al., 2003). The most recent studies in this field were conducted by Toro et al. (Martinez-Mallén et al., 2007; Toro et al., 2003), who observed significant improvements in physiological responses (reductions in blood pressure and heart rate), as well as a decrease in subjective anxiety, bingeing, and purging after 12 exposure sessions (twice a week over six weeks) in the therapist's office (sessions in which participants were asked to touch, smell, look at, and handle food, but could not eat it). These positive results were maintained during the follow-up period both in the short term (4–20 months follow-up) and in the long term (2.5–3 years follow-up).

However, the constraints associated with this approach make its implementation difficult. As Koskina et al. (Koskina, Campbell, & Schmidt, 2013) suggest, more research and new ways of applying these treatments are needed in order to overcome existing limitations such as logistical difficulties, the time required to carry them out, and the need for natural environments adapted to the requirements of each patient. For example, it can be difficult to gather together the actual foods (and their amounts) that a patient usually binges on, and it may not be possible to access the natural environment where binges occur. A further drawback is that carrying out cue exposure therapy (CET) in the therapist's office reduces its ecological validity, so that the generalization and maintenance of outcomes is likely to be poorer than would be the case when working in the natural environment where patients usually binge.

In recent years, virtual reality (VR) technologies have been proposed to offer a new and valid way of applying cue exposure in the treatment of EDs (Koskina et al., 2013). Different authors (Ferrer-García, Gutiérrez-Maldonado, Caqueo-Urízar, & Moreno, 2009; Gutiérrez-Maldonado, Ferrer-García, Caqueo-Urízar, & Letosa-Porta, 2006) have highlighted the advantages of VR exposure in relation to EDs, not least that it helps overcome the limitations of in vivo exposure. By simulating the real-world environments in which bingeing occurs, virtual reality exposure therapy (VRET) achieves greater ecological validity than does in vivo ERP-B conducted in the therapist's office. Consequently, this promotes greater generalization and maintenance of outcomes. In addition, VR is perceived as a relatively safe context for patients, so it is generally better accepted than in vivo cue exposure as a prior contact with the real world. A further point is that as VRET is performed in the laboratory, it does not invade the privacy of patients, since it is not necessary to enter their homes or the real contexts where binges occur. Finally, it also enables strict control over variables, and this allows the researcher to carry out the intervention at any time depending on the patient's responses.

This approach has been widely used in the field of addictions, and several studies have been published to date. Bordnick, Graap, Copp, Brooks, and Ferrer (2005), for example, developed the first VR cue reactivity program for nicotine dependence. The aim here was to expose participants to "drug"-related settings (e.g., potlucks or parties) and other relevant stimuli so as to create sensations similar to those that would be experienced in the real world (Bordnick, Carter, & Traylor, 2011).

More recently, a number of studies have demonstrated the effectiveness of VR as a way of eliciting emotional responses such as anxiety and depression in patients with EDs. The first studies of this kind were conducted by Gutierrez-Maldonado and colleagues (Ferrer-García et al., 2009; Gutiérrez-Maldonado et al., 2006), who created five virtual environments representing situations that were emotionally significant to subjects with EDs (a kitchen with high-calorie food, a kitchen with low-calorie food, a restaurant with high-calorie food and other people present, a restaurant with low calorie-food and other people present, and a swimming-pool with people in bathing suits) and then measured their levels of state anxiety and depression after exposure to each one. The authors concluded that by simulating real-life stressful situations, these environments were effective in producing significant emotional reactions in their users.

In light of these findings, we believe it is necessary to develop more diverse virtual environments based not only on the literature but also on the reports of ED patients who present bingeing behavior. By doing so it would be possible to expose participants to a greater number of situations, thereby increasing the likelihood of generalizing bingeing extinction.

Factors contributing to binge eating

Several studies have examined the characteristics of binge eating behavior and the scenarios and conditions associated with it (Abraham & Beumont, 1982; Allison & Timmerman, 2007; Engelberg, Gauvin, & Steiger, 2005; Johnson, Schlundt, Barclay, Carr-Nangle, & Engler, 1996; Schlundt, Johnson, & Jarrell, 1985; Steiger et al., 2005). One of the aims in this regard has been to identify specific triggers or cues for food craving so as to improve therapeutic interventions and the assessment of obesity and EDs.

Negative affect is the most frequently reported antecedent of binge eating (Haedt-Matt & Keel, 2011; Stickney, Miltenberger, & Wolff, 1999). In 1999, Stickney et al. concluded that negative emotions such as feeling depressed, angry, empty, hopeless, worried, or dissatisfied were the most frequent proximal antecedents to bingeing (Stickney et al., 1999). Recently, Haedt-Matt and Keel (2011) found that individuals experience above average levels of negative affect prior to binge eating episodes.

Dietary restraint (Engelberg et al., 2005; Steiger et al., 2005) and increased levels of hunger (Johnson et al., 1996) are other commonly reported antecedents. For example, as long ago as 1985, Schlundt et al. found that extreme hunger ratings were strongly associated with binge craving in a bulimic sample (Schlundt et al., 1985). More recently, Engelberg et al. (2005) noted that dietary restraint contributes to binge cravings rather than being a direct antecedent of bingeing. Given these findings, some authors have concluded that engaging in dietary restraint may lead to an increase in the reinforcing quality of foods for the individual (Stickney et al., 1999). However, not all studies support these results. According to the Counteractive Control Theory (Trope & Fishbach, 2000), exposure to high-fat cues reinforces restrained eaters' dieting goals rather than contributing to binge craving. Consequently, although hunger is associated with wanting to eat, no direct relation