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Cue-Elicited Anxiety and Craving For Food Using Virtual Reality Scenarios

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Abstract. Cue exposure therapy has been reported to be an effective intervention for reducing binge eating behavior in patients with eating disorders and obesity. However, in vivo food exposure conducted in the therapist's office presents logistical problems and lacks ecological validity. This study proposes the use of virtual reality technology as an alternative to in vivo exposure, and assesses the ability of different virtual environments to elicit anxiety and craving for food in a non-clinical sample. The results show that exposure to virtual environments provokes changes in reported craving for food. High-calorie food cues are the ones that elicit the highest increases in craving.

Keywords. Virtual reality, cue exposure, food craving, anxiety, non-clinical sample.

Introduction

Eating disorders (ED) and obesity are major problems in today's society. Though certain treatment approaches such as cognitive-behavioral therapy (CBT) have proved effective, a large percentage of patients do not greatly improve or suffer relapses. Therefore, new intervention techniques must be explored.

Binge eating behavior has been associated with both ED and obesity. Previous studies have proposed that cue-exposure therapy may be an effective intervention for bingeing [1-7]. In these studies, patients were exposed to binge food but were prevented from bingeing: they could look at, smell, touch, and even consume a small portion of the food, but they could not engage in binge behavior. The objective of cue-exposure therapy is to extinguish physiological responses such as craving and anxiety which are elicited in presence of binge-related cues and increase the probability of bingeing [2,3,5].

Though few studies have been carried out to date, cue-exposure therapy has shown positive results in BN [8], even in patients who did not improve with CBT or pharmacological treatments [6]. However, in vivo food exposure conducted in the therapist's office presents logistical problems and lacks ecological validity [8]. Virtual reality (VR), which allows the displaying of food cues in a contextual setting, may increase ecological validity and facilitate the availability of proximal and contextual cues [9-11]. The main objective of this study was to assess whether VR environments

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simulating intake situations can provoke different levels of anxiety and craving for food in a non-clinical sample.

1. Methods

1.1. Participants

Fifteen men and 68 women were recruited from the population of students of the Faculty of Psychology at the University of Barcelona (Spain) and received course credits as compensation for their participation. Age ranged from 21 to 43 (*M*= 23.91, *SD*=3.80) and body mass index (BMI) from 16.85 to 39.31 (*M*= 22.70, *SD*=3.91). Two female participants reported history of an ED during adolescence. All participants gave written consent to participate in the study and were informed that they could withdraw at any time during the experiment. Table 1 shows data for men and women separately.

Table 1. Between-subject *t*-test, means, and standard deviations for age, BMI, and EAT-26 scores in men and women.

	Men		**Women**		*t*	*p*
	Mean	*SD*	Mean	*SD*		
Age	25.47	4.61	23.57	3.55	1.495	.152
BMI	23.93	2.99	22.43	4.06	1.343	.183
EAT-26	1	1.60	3.85	5.86	3.468	.001*

*p<.05

1.2. Assessment

- ED symptoms: Measured with the Spanish version [12] of the Eating Attitudes Test-26 (EAT-26) [13].
- Anxiety: Measured with a visual analogical scale (0-100)
- Food craving: Measured with a visual analogical scale (0-100)

1.3. Procedure

Before starting the experiment, participants were administered the EAT-26 and demographic information was recorded. They were also measured and weighed in order to obtain their BMI. During the experiment, participants were first exposed to a blank screen on a laptop. After two minutes of exposure, anxiety and food craving were assessed. Next, participants were exposed in random order to four virtual environments (VEs): a low-calorie kitchen, a high-calorie kitchen, a low-calorie restaurant, and a high-calorie restaurant. VEs were displayed by means of software which creates a stereoscopic effect, duly processed by polarized glasses. Anxiety and craving for food were assessed after two minutes of passive exposure. Once the exposure to each virtual environment was completed, participants were again exposed to the blank screen for two minutes in order to return to the base line condition, and anxiety and craving were measured again.

1.4. Statistical analysis

Since significant differences were found between males and females on the EAT-26 scores (see table 1), two mixed between-within subject ANOVAs 5(situation) x 2(sex) were conducted to assess the ability of the VE to elicit anxiety and food craving in participants. The mean scores obtained for anxiety and craving in front of the blank screen were used as baseline in the analysis. Two more mixed between-within subject ANOVAs 2x2x2 were also conducted in order to assess the specific influence of the kind of food (low-calorie versus high-calorie) and the contextual stimuli (kitchen versus restaurant) on the anxiety and food craving experienced by males and females. In all the analyses, time elapsed since the last meal was introduced as a covariate to control cue responses produced by food deprivation.

2. Results

Mixed between-within subject ANOVAs (5x2) showed no significant differences between the mean score for anxiety obtained in front of the blank screen and the anxiety experienced in the different VEs, but the interaction between the sex of participants and the situation showed a significant effect (F[4, 82]=2.507; p=.049; η^2=.12). Men felt more anxious in situations with low-calorie food, while women displayed higher anxiety in high-calorie food environments.

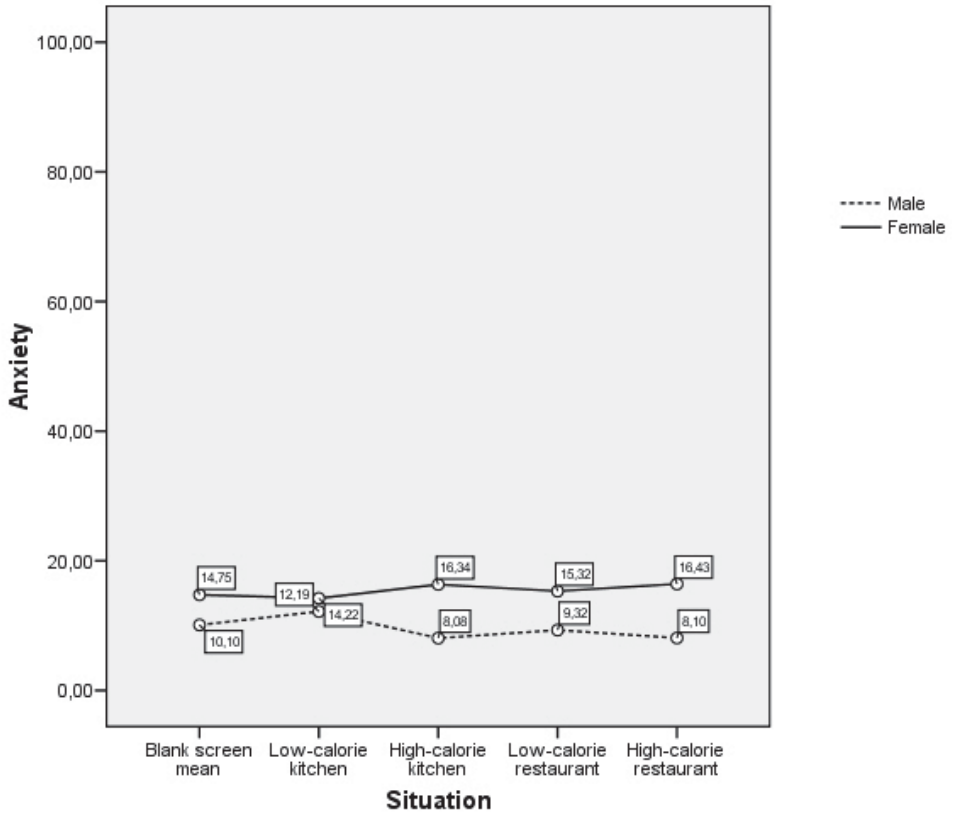

Figure 1. Anxiety experienced for males and females in the different situations

On the other hand, significant differences were found between levels of craving for food in the blank screen situation and in the VEs (F[4, 82]=5.161; p=.001; η^2=.21). Situations with high-calorie food provoked higher levels of food craving in both males and females.

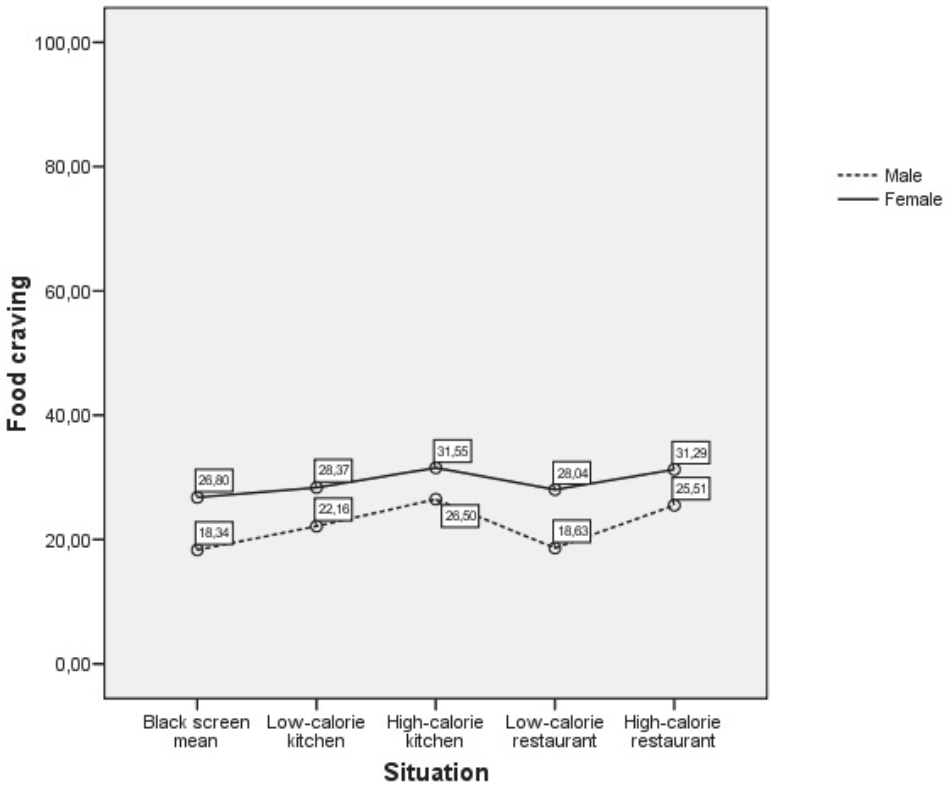

Figure 2. Craving for food experienced for male and females in the different situations

Mixed between-within subject ANOVAs (2x2x2) showed no significant effects of the kind of food or the context on the anxiety experienced by participants, but the interaction between the kind of food and sex was significant (F[1, 81]=5.291; p=.024; η^2=.064). Men showed more anxiety when exposed to low-calorie than to high-calorie food, while women were more anxious when exposed to high-calorie food. The kind of food was the only variable to show a significant effect on food craving (F[1, 81]=10.299; p=.002; η^2=.115): high-calorie food produced higher food craving than low-calorie food.

3. Conclusions

VR cue exposure proved to be an effective procedure for eliciting craving for food in a non-clinical sample. Exposure to high-calorie food produced the highest levels of food craving both in males and females. On the other hand, no significant changes in reported anxiety were found. Anxiety and craving for food are considered to be antecedents of binge eating behavior. However, since participants in this study were from a non-clinical sample, no cue-elicited anxiety was produced. Results suggest that

VR could be a useful technology for cue-exposure therapy in the treatment of binge eating. Future research should assess the capability of VR environments to elicit food craving and anxiety responses in patients with ED and obesity. The sex differences found here should also be explored further.

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