

Development of a VR Application for Binge Eating Treatment: Identification of Contexts and Cues Related to Bingeing Behavior in Spanish and Italian Patients

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Abstract. The objective of this study was to identify frequent situations and specific cues that produce the craving to binge in Spanish and Italian samples of patients with eating disorders (ED). There were two main aims: to assess transcultural differences in the contexts and cues that elicit food craving; and to develop valid, reliable VR environments for effective cue-exposure therapy (CET) for patients from both countries. Twenty-six Spanish and 75 Italian ED patients completed an *ad hoc* questionnaire to assess contexts and cues that trigger the craving to binge. No differences between groups were found. All patients reported experiencing higher levels of craving in the afternoon/early evening and in the late evening/night, between meals, when alone, and more frequently at the end of the week. Being in the dining room, the kitchen, the bedroom, the bakery and the supermarket were the specific situations that produced the highest levels of craving to binge. We used the questionnaire results to develop a virtual reality application for CET.

Keywords: Virtual reality, food craving, binge eating, cue-exposure therapy, clinical sample

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Introduction

Cue-exposure therapy (CET) has proved effective in binge eating treatment in patients with bulimia nervosa (BN) and binge eating disorder (BED) [1-6]. However, logistical drawbacks and a lack of ecological validity have prevented the widespread use of this intervention [7-8]. Virtual reality (VR) technology allows the simulation of real life situations. It increases ecological validity and facilitates the availability of both contextual and proximal cues, while maintaining good control over situational parameters. Consequently, VR could be a good alternative to in vivo exposure in CET [9].

The objective of this study was to identify frequent situations and specific cues that produce the craving to binge in Spanish and Italian samples of patients with eating disorders (ED). The study had two main aims: first, to assess transcultural differences in the contexts and cues that elicit food craving; second, to develop valid, reliable VR environments for CET that are applicable to both groups.

1. Procedure

One hundred and one ED patients (50 BED and 51 BN-purgative subtype) participated in the study. Twenty-six participants were Spanish and 75 were Italian. Eighty-eight percent were female. The mean age was 30.1 years ($SD=8.02$, range 18 to 54). Forty-three of the participants were considered to be of normal weight ($BMI = 18.5-24.99$), 39 were overweight ($BMI = 25-29.99$), and 19 were obese ($BMI = 30+$). The sample was recruited from three hospitals in the area around Barcelona (Spain) and Milan (Italy), each of which was collaborating with the research project. The protocol was previously reviewed and approved by the corresponding Ethics Committees of these institutions. Inclusion criteria were as follows: having an ED diagnosis according to DSM-5 criteria, presenting binge eating behavior, and being over 18 years old. Participants were excluded if they had any comorbid psychotic disorder. All participants signed an informed consent form.

No differences in body mass index (BMI) and symptom severity (assessed with the BULIT-R) were found between the Italian and Spanish groups. All participants completed an *ad hoc* questionnaire developed on the basis of the literature [10-12] to assess the level of binge craving in different areas related to binge eating: meal, time of the day, day of the week, presence of others, situations, mood, hunger, and types of food. For each area that was assessed, we included different items that required participants to imagine the specific situation, to try to visualize it, and to indicate their desire to binge on a Likert scale ranging from 0 (no desire) to 4 (very high desire). Participants were also asked to describe in a blank text box which of the stimuli present in that context made them want to binge. Demographic items were included at the beginning of the questionnaire to gather information about age, diagnosis, weight, height, and BMI. The inventory showed good internal consistency both in the Spanish (Cronbach's $\alpha = 0.90$) and the Italian (Cronbach's $\alpha = 0.81$) samples.

Descriptive analyses were conducted separately for the Spanish and the Italian groups, to find which contexts and specific cues provoked higher levels of food craving in the BED and BN patients of each country. Likewise, several independent-samples *t*-tests (applying the Bonferroni adjustment to the alpha level) were conducted to assess differences between groups.

2. Results

Table 1 shows the mean binge craving level in the Spanish and Italian samples for each craving-inducing context that was assessed, as well as the results of *t*-tests. No significant differences between groups were found. Both Spanish and Italian patients showed higher levels of craving in the afternoon/early evening (between 4.01 and 8. p.m.) and in the late evening/night (between 8.01 p.m. and midnight), between meals, when alone, and more frequently at the end of the week on Friday, Saturday and Sunday. Among the specific situations that were assessed, being in the dining room, the kitchen, the bedroom, the bakery, and the supermarket were those that produced the highest levels of binge craving. The most frequently reported specific cue in all the situations was the presence of palatable food. Being hungry and a negative mood were also strongly associated with craving.

Table 1. Mean binge craving levels for triggering contexts in the Spanish and Italian samples, and the results of the independent-samples *t*-tests

Context	Spanish sample	Italian sample	<i>t</i>	<i>P</i>
	<i>M</i> (<i>SD</i>)	<i>M</i> (<i>SD</i>)		
Meal				
Breakfast	1.16 (1.52)	0.88 (1.10)	.850	.401
Lunch	1.42 (1.32)	1.67 (1.09)	-.842	.406
Snack	2.54 (1.24)	2.17 (1.03)	1.348	.186
Dinner	2.42 (1.42)	2.97 (0.96)	-1.837	.075
Between meals	3.04 (1.08)	3.03 (0.96)	.061	.952
Presence of others				
Being alone	3.42 (0.83)	3.56 (0.53)	-.797	.432
Family	1.80 (1.29)	1.79 (1.02)	.047	.963
Friends	1.52 (1.33)	1.45 (0.95)	.228	.822
Situations				
Kitchen	2.33 (1.37)	2.63 (1.44)	-.878	.382
Bedroom	1.96 (1.46)	2.55 (0.98)	-1.817	.080
Dining room	2.52 (1.39)	2.87 (1.11)	-1.134	.264
At work/ college	1.41 (1.40)	1.32 (0.68)	.288	.776
Restaurant	1.91 (1.47)	1.76 (1.06)	.462	.647
Cafeteria	1.78 (1.59)	1.64 (0.83)	.412	.684
Bakery	2.71 (1.55)	2.17 (1.42)	1.574	.119
Supermarket	2.17 (1.58)	2.17 (1.02)	-.019	.985
Outdoor place	1.04 (1.37)	1.00 (0.75)	.143	.888
Preparing food	1.79 (1.44)	1.52 (1.19)	.923	.358
Party	1.87 (1.63)	1.49 (0.86)	1.061	.298
Starting to eat	1.92 (1.56)	1.84 (0.81)	.231	.819
Time of day				
5:01-9:00	0.73(1.32)	0.87 (0.62)	-.481	.635
9:01-13:00	1.50 (1.22)	1.41 (0.96)	.349	.728
13:01-16:00	2.08 (1.32)	2.04 (1.10)	.160	.873
16:01-20:00	2.75 (1.19)	2.79 (1.13)	-.137	.892
20:01-24:00	2.85 (1.01)	2.97 (0.80)	-.649	.518
24:01- 5:00	1.78 (1.93)	1.79 (1.19)	-.010	.992

Day of the week				
Monday	2.60 (1.09)	2.48 (0.86)	.522	.603
Tuesday	2.45 (1.19)	1.96 (0.83)	1.731	.096
Wednesday	2.43 (0.87)	2.16 (0.89)	1.233	.221
Thursday	2.86 (0.85)	2.65 (.95)	.886	.378
Friday	2.91 (0.92)	3.15 (0.36)	-1.184	.249
Saturday	3.17 (0.98)	3.35 (0.48)	-.813	.424
Sunday	3.14 (1.21)	3.19 (0.39)	-.193	.849
Mood				
Bored	3.16 (1.03)	3.27 (0.89)	-.499	.619
Stressed	3.00 (1.22)	3.01 (1.01)	-.055	.956
Anxious/Tense	3.50 (0.66)	3.50 (0.51)	.000	1.00
Irritable	2.67 (1.31)	2.75 (1.14)	-.289	.774
Frustrated	3.13 (1.18)	2.97 (0.90)	.579	.565
Angry	2.32 (1.57)	2.52 (1.48)	-.575	.566
Depressed	3.12 (1.30)	3.35 (1.01)	-.904	.368
Quiet	1.21 (1.35)	0.85 (1.02)	1.184	.245
Happy	0.86 (1.21)	0.43 (0.66)	1.628	.116
Euphoric	1.00 (1.41)	0.76 (0.87)	.771	.448
Hunger				
Very hungry	2.68 (1.45)	2.60 (1.06)	.237	.815
Quite hungry	2.75 (1.18)	2.92 (1.01)	-.593	.555
Moderately hungry	1.93 (1.03)	1.92 (1.14)	.042	.967
Not very hungry	1.31 (0.79)	1.21 (0.78)	.462	.645
Not hungry	0.81 (1.05)	0.73 (1.02)	.281	.779

Conclusions

No differences between Spanish and Italian samples were found. Both groups experienced higher levels of food craving in the same contexts and with the same cues. We used the results of the questionnaire to develop a VR application for CET. The software consists of four VR environments (kitchen, dining-room, bedroom, and bakery/cafe) and 30 palatable foods that can be combined to construct an exposure hierarchy adapted to the specific needs of each patient. The therapeutic aim of this application is to extinguish a conditioned craving response and facilitate the generalization of craving extinction.

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