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# Induction of food craving experience; the role of mental imagery, dietary restraint, mood and coping strategies

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## Abstract

**Introduction:** Food craving consists of a strong motivational state whereby a person is driven to seek and ingest a specifically desired food.

**Objectives:** To explore the influence of mental imagery on the food craving experience as well as to analyse the role of different psychological variables.

**Methods:** Participants consisted of 65 normal weight undergraduate students. An experimental induction of food craving was analysed considering the actual previous craving and the induced one as a state food craving. Measures of trait food craving, imaging ability, dietary restraint, anxiety, depression, and coping strategies were considered.

**Results:** Sweet foods in general and chocolate in particular were the most craved foods. During the induction thoughts and images were the most highly rated triggers, and all the different sensory modalities were involved. Anxiety, depression, and negative coping strategies influenced the results with regards to the food craving.

**Discussion:** This study confirms the role of mental imagery, the correlation between state and trait food craving, and the influence of different psychological variables on the food craving.

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Key words: *Food craving. Mental imagery. Dietary restraint. Mood. Coping strategies.*

## INDUCCIÓN DE LA EXPERIENCIA DE “FOOD CRAVING”; PAPEL DE LAS IMÁGENES MENTALES, RESTRICCIÓN DIETÉTICA, HUMOR Y ESTRATEGIAS DE AFRONTAMIENTO

### Resumen

**Introducción:** El food craving se define como un fuerte estado motivacional por el que una persona se ve impulsada a buscar e ingerir un alimento específicamente deseado.

**Objetivos:** Explorar la influencia de las imágenes mentales sobre la experiencia de food craving, así como analizar el papel de diferentes variables psicológicas.

**Métodos:** Los participantes fueron 65 estudiantes de pregrado de peso normal. Se analizó un modelo de provocación experimental de food craving teniendo en cuenta el deseo real previo al experimento y el inducido durante el mismo como medida de estado. Medidas de food craving habitual, capacidad de formación de imágenes, restricción dietética, ansiedad, depresión y estrategias de afrontamiento fueron consideradas.

**Resultados:** Los alimentos dulces en general y el chocolate, en particular, fueron los alimentos más ansiados. Durante la inducción, los pensamientos y las imágenes fueron los desencadenantes más potentes y todas las modalidades sensoriales estuvieron involucradas. Las variables ansiedad, depresión y estrategias de afrontamiento negativas influyeron en los resultados con respecto al food craving inducido.

**Discusión:** Este estudio confirma el papel de las imágenes mentales, la correlación entre estado y rasgo de food craving y la influencia de diferentes variables psicológicas en el mismo.

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Palabras clave: *Food craving. Imágenes mentales. Restricción dietética. Humor. Estrategias de afrontamiento.*

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## Introduction

Food craving consists of a strong motivational state whereby a person is driven to seek and ingest a specifically desired food.<sup>1</sup> Neurochemical and psychological (subjective) aspects are involved in the experience of craving<sup>2</sup> and this experience differs from ordinary food choices or hunger in its intensity and the specificity of the craved food.<sup>3</sup> Food craving occurs in non-clinical (as a normative everyday experience) and clinical groups (i.e., binge eating, bulimia nervosa, and obesity) and it has been associated with guilt, depression and impairment in cognitive performance.<sup>1,4-7</sup> Moreover, food craving usually precedes binge eating in bulimia nervosa and obesity, binge eating disorder, seasonal affective disorder, and premenstrual syndrome.<sup>8</sup>

Among the biological triggers of the food craving, hunger, nutritional deficits, and nutritional deprivation have been repeatedly considered, as well as the menstrual-related changes.<sup>9,10</sup> Nevertheless, other psychological (i.e., affective, cognitive) triggers have been mentioned, as for example negative mood states, expectations and cognitions.<sup>1,11</sup> It is important to mention that while associations between craving and binge eating have been reported, multiple observations indicate that not all those who experience food cravings binge on the desired food.<sup>5</sup> In fact, it has been assumed that craving would be an extreme instance of a range of normal phenomena associated with motivated consumption behaviours.<sup>2</sup> The role of dietary restraint in the experience of food craving is controversial and it has been suggested that the relationship between dietary restraint and food craving may be a function of how craving is operationalized (e.g., frequency, intensity), the dietary restraint being related to general or aggregated measures of food craving, rather than to single episodes.<sup>12</sup>

Cognitive psychology considers that phenomenological experiences can be measured with the method of the experimental psychology.<sup>13</sup> In this regard two main theories of the nature of everyday craving have emerged. On the one hand, Tiffany's theory (as expressed within the Interacting Cognitive Subsystems model) implies that craving episodes would be triggered by means of generated somatovisceral responses to high-level schematic thoughts about a substance (i.e. a specific food) or by a person noticing their overt behaviour. In this case, conscious inspection is possible, so the person is able to attribute the triggering causes of the craving.<sup>2,14,15</sup> On the other hand, the Elaborated Intrusion theory does not assume that people have any direct access to the processes that triggered an intrusive thought, and therefore suggests that people may often have little insight these triggers.<sup>2,16</sup> In the Elaborated Intrusion theory the imagery is a key element of craving, providing the subjective experience and mediating much of the associated disruption of concurrent cognition.<sup>2</sup>

The role of mental imagery in the experience of food craving episodes has been longer reported, the former studies reporting food-related images in craving experiences.<sup>17</sup> Food cravings may be induced by imagery instructions and the intensity of the craving may be increased following specific instructions to imagine a food script. In addition, a positive correlation between self-reported vividness of the imagined food script and the craving intensity has been found.<sup>17-19</sup> With respect to specific images, all the different sensory modalities have been, more or less, involved in the food craving experiences.<sup>2</sup>

In a study of everyday cravings, cravers tended not to attribute their thoughts about a substance to any identifiable cue in the environment, but reported them as spontaneous or due to somatovisceral sensations, and involving olfactory or visual imagery.<sup>2</sup> In other study on food cravings, the specific sensory modalities most involved were visual and gustatory, followed by olfactory.<sup>12</sup> There was little involvement of auditory or tactile modalities. Apart from the mental imagery, other psychopathological variables, as anxiety or depression have been widely related with food craving, especially in patients with bulimia nervosa.<sup>20,21</sup> From a psychophysiological point of view, a decreased reactivity of the autonomic nervous system linked to a negative affect (anxiety and depression among others) has been reported in different psychopathological disorders included bulimia nervosa.<sup>22</sup>

The aim of the current study was to explore the role of the mental imagery in the food craving experience. The specific objectives were to explore: a) the relationship between the vividness of the mental images and the intensity of the craving; b) the possible relations between food craving and specific sensory modalities involved in those images; c) the role of the dietary restraint; and d) the influence of coping strategies, anxiety and depression on the relationship between mental imagery and food craving.

## Method

### *Participants*

The sample consisted of 65 normal weight undergraduate students (54 women, 11 men) at Pablo de Olavide University who participated in their established regular practices during the course 2010-2011. The range of age was 19-31 years, with  $M = 23.19$  and  $SD = 3.74$ . None of the participants was suffering neither from an eating disorder nor any other psychological disorders at the moment of the study, this being assessed by means of a clinical interview. None of the participants was on diet and the level of hunger was fair ( $M = 6.2$ ,  $SD = 1.8$ ) and none had eaten within the three hours before the experiment.

## Procedure

Students were asked to express an actual previous craving experience by way of a questionnaire. Then students filled in other different questionnaires administered randomly, thus reducing potential biases. After that, the experimental induction of food craving was analysed in the laboratory setting. Like other authors,<sup>12</sup> the actual previous craving and the induced one were considered as a state food craving. Finally, different measures were taken, including the trait food craving as well as imaging ability, dietary restraint, anxiety, depression, and coping strategies.

## Instruments

*a) The actual previous craving experience.* After explaining in what the food craving consists of, students were asked to think back to the last time they had a food craving experience. The specific instruction was to recall the experience as clearly as they could, really putting themselves into the situation. After that, participants wrote a paragraph describing the experience in detail and were asked to score the intensity of their craving by means of a 10-point scale (from 1 = *very slight* to 10 = *overwhelming*) and to specify the food involved in the experience. In order to assess the triggers for the craving, a list with 14 different potential triggers<sup>2,12</sup> was administered and students were asked to rate each one on a 5-point Likert scale (from 1 = *not at all* to 5 = *definitely*). Potential triggers included biological (hunger), affective (stress), external cues (smelt the food), thoughts and mental imagery.

*b) The induced food craving experience.* Basically the induction consisted of asking participants to think about their favourite food and imagine they were eating it. Following the above-mentioned specific instruction, students were asked to bring the experience to mind as clearly as they could, in detail. Then, they were instructed to rate the vividness of their image (from 1 = *no image at all* to 10 = *image perfectly clear*). The current urge to eat the imagined food was rated too (from 1 = *no desire or urge* to 10 = *extremely strong desire or urge*), and students were instructed to describe the experience by scoring 10 descriptors<sup>2,12</sup> on 5-point scales (from 1 = *not at all* to 5 = *definitely*). Finally, participants rated the sensory descriptors (five sensory modalities) on 10-point scales (from 1 = *not at all* to 10 = *definitely*).

*c) Other measures.* Based on previous studies, the following measures were included, having been demonstrated some relationship with the phenomenon of food craving.

*c1) Habitual food craving.* The trait food craving was measured by means of the Spanish version of the Food Craving Inventory (FCI).<sup>23,24</sup> This version consists of 28 self-reported items scored from 0 to 4 (where 0 = *never*; 1 = *rarely*; 2 = *sometimes*; 3 = *often*; and 4 = *always/almost every day*) according to the

strength of the craving. The Spanish version of the FCI yielded three factors (*single sugars/trans fats, complex carbohydrates/proteins, and saturated fats/high calorie content —fast food—*) and showed adequate internal consistency (Cronbach's  $\alpha$  coefficients between 0.91 and 0.95) and psychometric properties.

*c2) Mental imagery.* The Spanish version of the shortened form of Bett's Questionnaire Upon Mental Imagery was used.<sup>25</sup> This questionnaire assesses the general imaging ability with respect to the different sensory modalities (visual, auditory, cutaneous, kinaesthetic, gustatory, olfactory, and organic). Participants are asked to rate their thoughts with respect to the vividness of the resulting mental images (from 1 = *perfectly clear and as vivid as the actual experience* to 7 = *no image present at all, you only 'know' that you are thinking of the object*). The Spanish version of this questionnaire has shown an adequate internal consistency (Cronbach's coefficient = 0.92).

*c3) Dietary restraint.* It was measured by means of the Spanish version of the Revised Restraint Scale,<sup>2,26</sup> which consists of 10 items (e.g., *how often do you diet?*) measuring weight fluctuation (4 items) and concern for dieting (6 items), which are scored on a 4- or 5-point Likert scales (total score ranges from 0 to 35). The Spanish version of this scale has shown an adequate internal consistency (Cronbach's  $\alpha$  coefficient = 0.78 for the concern for dieting subscale, and Cronbach's coefficient = 0.70 for the weight fluctuation subscale).

*c4) Anxiety.* Anxiety was measured by means of the Spanish version of the State-Trait Anxiety Inventory (STAI).<sup>28,29</sup> This is a 40-item self-report questionnaire, which measures state anxiety (STAI-S) and trait anxiety (STAI-T). Items are scored from 0 to 3, where 0 = *not at all* and 3 = *a lot*. As regards reliability and discriminant validity the STAI items show a sufficient ability to discriminate and differentiate (between age, sex and anxiety levels) and have a good internal consistency (between 0.90 and 0.93 for the STAI-S and between 0.84 and 0.87 for the STAI-T). The convergent validity with respect to other measures of anxiety ranges from 0.58 to 0.79.

*c5) Depression.* Depression was assessed by means of the Spanish version of the Beck Depression Inventory (BDI),<sup>30,31</sup> which measures the intensity of depression and is used as a screening test in the general population. It is a self-report instrument comprising 21 items and four response levels (0 to 3 for each item). The scores obtained are linked to three categories: absence of depression (0-9), dysthymia or mild depression (10-15) and depression (over 15). The BDI shows adequate reliability (0.93) and a convergent validity between 0.62 and 0.66.

*c6) Coping Strategies.* They were assessed by means of the Coping Strategies Inventory (CSI).<sup>32,33</sup> This instrument consists of a test in which eight primary strategies, four secondary and two tertiary are explored, on the basis of the description of a stressful situation. After that, the individual answers 40 items,

following a Likert scale consisting of 5 points so that they tell how often, in the described situation, they did what is expressed in each item. At the end they answer, in an item, about the perceived coping self-efficacy. Following a previous study,<sup>34</sup> two conditions were established in this one: a) “high/not high problem-focused engagement” (Percentile > 50/ ≤ 50) and b) “high/not high emotion-focused engagement” (Percentile > 50/ ≤ 50).

### Statistical analyses

Conventional descriptive statistics (*M*, *SD*) were used to describe characteristics of the sample. Comparisons between groups were tested by means of an ANOVA and  $\chi^2$ -test was used to determine differences with respect to categorical variables. Different associations among variables were analysed with the Pearson’s correlation coefficient and a regression analysis was performed to test the possible predictors of the urge to eat the food during the favourite food craving experience.

### Results

Considering the recall of the food craving experience detailed in the paragraph previously written, 38.46% of the participants imagined that they were “at home”, followed by those who imagined themselves “walking in the street” (10.77%) and those who imagined themselves “in a cafeteria, restaurant or ice-cream saloon” (7.69%).

The main activities in which they were involved were “walking, waiting for the bus, in the car” (12.31%), “studying” (10.77%), “watching TV or a movie” (9.23%), “attending classes” (7.69%) or “travelling” (4.62%).

With regards to the imagined thoughts and/or feelings, they mainly referred “confusion” (12.31%), “recalls” (12.31%), “tiredness” (7.69%), “stress” (6.15%) or “feelings of guilt” (4.62%).

As examples of the consequences of their experience they mentioned “to eat” (41.54%), “to buy food” (15.38%) and “drinking water” (5.41”).

### Craving experience

With respect to the sweet and salty foods, sweet foods were the most craved ones (56.9%). Regarding the specific foods, chocolate was the most craved (21.5%), followed by other foods like pastries (12.3%). Among those who craved sweet foods, 52.31% were women ( $\chi^2 = 0.27$ ; *df* = 1; *p* = 0.05), and among those who craved chocolate, 64.10% were women ( $\chi^2 = 20.36$ ; *df* = 10; *p* = 0.01). With regards to other foods, more men craved a meal (e.g., meat) or fast foods (e.g., pizza). There was a significant difference between sweet and salty foods on the score of the *single sugars/trans fats* subscale of the FCI with a mean of 17.32 (*SD* = 9.14) for sweet foods and a mean of 11.93 (*SD* = 8.76) for salty foods ( $F_{1,64} = 5.75$ ; *p* < 0.01).

Among the 14 studied triggers for the food craving experience, the highest mean score corresponded to *I imagined the smell/taste of it* (*M* = 3.46), followed by *I suddenly thought about the food* (*M* = 3.38), *I pictured myself having it* (*M* = 2.91) and *I felt hungry* (*M* = 2.74). The lowest scores were obtained for *I always have it at that time/place* (*M* = 1.66) and *I imagined the sound of myself having it* (*M* = 1.66).

Taking into account the craving intensity, different significant and positive correlations were found. Thus, the craving intensity was correlated with the following triggers: *I imagined the smell/taste of it* (*r* = 0.41; *p* < 0.001), *I pictured myself having it* (*r* = 0.29; *p* < 0.05), and *I saw it* (*r* = 0.25; *p* < 0.05). The mean craving intensity was 7.09 (*SD* = 1.94). Craving intensity did not correlate neither with the three subscales of the FCI nor with the total score on the FCI.

Correlations among the three factors of the FCI and the different triggers were also explored. These correlations are shown in table I (only the significant correlations are presented). The following triggers did not

**Table I**  
Correlations among triggers and scores on PCI

	FC1	FC2	FC3	Total FC
I imagined the smell/taste of it	0.31*	0.01	0.17	0.26*
I pictured myself having it	0.29*	0.13	0.21	0.31*
I saw it	0.09	0.11	0.31*	0.19
I heard it	0.02	0.42**	0.21	0.25**
I smelt it	0.22	0.35**	0.25	0.36**
Other things I was thinking about reminded me of it	0.06	0.28*	0.13	0.20
I felt happy	0.17	0.19	0.31*	0.28*
I was really busy	0.32**	0.08	0.08	0.27*
I imagined the sound of myself having it	0.14	0.27*	0.21	0.26*

FC: Food craving; FCI: Food Craving Inventory; FC1: Single sugars/trans fats; FC2: Complex carbohydrates/proteins; FC3: Saturated fats/high calorie content —fast food—. \**p* < 0.05; \*\**p* < 0.01.



**Table II**  
Correlations among descriptors of the favourite food imagining experience and scores on FCI

	FC1	FC2	FC3	Total FC
Current urge to eat the food	0.25*	0.16	0.31*	0.32**
I want the food because I am hungry	0.01	0.32**	0.20	0.19
Thinking how much better I would feel after				
I have eaten it	0.35**	0.37**	0.36**	0.48**
I am imagining the taste of it	0.25*	0.06	0.24*	0.26*
I would feel more relaxed if I ate it	0.23	0.17	0.22	0.29*
I can hear myself eating it	0.01	0.30*	0.03	0.13

FC: Food craving; FCI: Food Craving Inventory; FC1: Single sugars/trans fats; FC2: Complex carbohydrates/proteins; FC3: Saturated fats/high calorie content —fast food—. \* $p < 0.05$ ; \*\* $p < 0.01$ .

correlate significantly with the scores on the FCI: *I suddenly thought about the food, I felt hungry, I had nothing else to do/I was bored, I felt stressed/anxious/sad, I always have it at that time/place.*

#### Favourite food induction

The mean of vividness imagining the favourite food was 7.09 ( $SD = 1.94$ ) and the mean of the current urge to eat the food was 5.05 ( $SD = 2.62$ ). With respect to the favourite food imagining experience, the mean ratings of the descriptors ranged between 1.23 (*I have it with me right now*) and 3.69 (*I am imagining the taste of it*). Following the latter highest score, the next two descriptors were also relevant (rates  $> 2.5$ ): *If I don't think about it, my craving will go away*, and *I want the food because I am hungry*. The correlations among the different descriptors of the favourite food imagining experience and the three factors of the FCI were explored. Table II shows these correlations (only descriptors with significant correlations are presented).

#### Sensory modalities involved during the favourite food induction

The mean rates for the different sensory modalities involved during the favourite food induction ranged between 5.72 (*I tasted the food*) and 2.88 (*I heard myself eating the food*). Table III shows the correlations among the sensory modalities, the vividness and the urge to eat the food, and the three factors of the FCI.

#### Dietary restraint and craving experience

There was only one significant correlation between the score on the Revised Restraint Scale and the different triggers for the food craving experience, this correlation being that one established between the dietary restraint and the trigger *I felt stressed/anxious/sad* ( $r = 0.37$ ;  $p < 0.01$ ). There was no significant corre-

lation between dietary restraint and the scores on the FCI.

#### Dietary restraint and favourite food imagining experience

The scores on dietary restraint were not correlated neither with the descriptors of the favourite food imagining experience nor with the sensory modalities involved during the experience.

#### General imaging ability, food craving experience and favourite food imagining experience

There was a significant and positive correlation between the score on the Bett's Questionnaire and the following triggers for the food craving experience: *I imagined the smell/taste of it* ( $r = 0.26$ ;  $p < 0.05$ ) and *I pictured myself having it* ( $r = 0.27$ ;  $p < 0.05$ ). With respect to the favourite food imagining experience, there was a significant and positive correlation between the score on the Bett's Questionnaire and the descriptor *I am imagining the taste of it* ( $r = 0.36$ ;  $p < 0.01$ ). Considering the different sensory modalities included in the Bett's Questionnaire and the sensory modalities descriptors during the favourite food imagining experience, the gustatory ( $r = 0.41$ ;  $p < 0.01$ ), olfactory ( $r = 0.25$ ;  $p < 0.05$ ), and organic ( $r = 0.28$ ;  $p < 0.05$ ) modalities were correlated with the urge to eat the imagined food. The descriptor *I saw the food* was correlated with gustatory ( $r = 0.33$ ;  $p < 0.01$ ) and organic ( $r = 0.28$ ;  $p < 0.05$ ) sensory modalities of the Bett's Questionnaire. The descriptor *I saw myself eating the food* was correlated with cutaneous ( $r = 0.26$ ;  $p < 0.05$ ), gustatory ( $r = 0.46$ ;  $p < 0.01$ ), and organic ( $r = 0.28$ ;  $p < 0.05$ ) sensory modalities. The descriptor *I smelt the food* was correlated with the organic modality ( $r = 0.37$ ;  $p < 0.01$ ), the descriptor *I tasted the food* was correlated with gustatory ( $r = 0.35$ ;  $p < 0.01$ ) and organic ( $r = 0.28$ ;  $p < 0.05$ ) modalities and, finally, the descriptor *I felt the texture of the food*

**Table III**  
Correlations among the sensory modalities, the vividness and the urge to eat the food, and the three factors of the FCI

	Mean	Vividness	Urge	FC1	FC2	FC3	Total FC
I saw the food	5.66	0.33**	0.50**	0.15	0.10	0.11	0.09
I saw myself eating the food	5.20	0.29*	0.35**	0.21	0.01	0.17	0.19
I heard myself eating the food	2.88	0.21	0.18	0.13	0.15	0.17	0.19
I smelt the food	3.92	0.28*	0.42**	0.24	0.26*	0.33**	0.36**
I tasted the food	5.72	0.40**	0.49**	0.18	0.10	0.18	0.21
I felt the texture of the food in my mouth	5.52	0.40**	0.56**	0.16	0.17	0.20	0.23

FC: Food craving; FCI: Food Craving Inventory; FC1: Single sugars/trans fats; FC2: Complex carbohydrates/proteins; FC3: Saturated fats/high calorie content —fast food—. \* $p < 0.05$ ; \*\* $p < 0.01$ .

*in my mouth* was correlated with the gustatory modality ( $r = 0.31$ ;  $p < 0.01$ ).

*May the urge to eat the food during the favourite food induction experience be predicted?*

A stepwise multiple regression analysis (entering as predictive variables age, sex, FCI scores, Bett's Questionnaire scores, descriptors of favourite food induction, sensory modalities descriptors, vividness during the favourite food induction, BDI scores and STAI scores) revealed the following to be predictors of the urge to eat the food during the favourite food induction experience: *I saw the food* ( $b = 0.61$ ;  $t = 4.95$ ;  $p < 0.0001$ ), *I would feel more relaxed if I ate it* ( $b = 0.40$ ;  $t = 3.56$ ;  $p < 0.001$ ), *I felt the texture of the food in my mouth* ( $b = 0.29$ ;  $t = 2.69$ ;  $p < 0.01$ ), and *I smelt the food* ( $b = 0.27$ ;  $t = 2.44$ ;  $p < 0.01$ ).

*The role of psychological and psychopathological variables (anxiety, depression and coping strategies)*

Anxiety symptoms, as measured by the STAI, were significantly correlated with dietary restraint considering the STAI-T ( $r = 0.26$ ;  $p < 0.05$ ), and with the

second factor of the FCI (*complex carbohydrates/proteins*) considering the STAI-S ( $r = 0.25$ ;  $p < 0.05$ ). Depression symptoms were significantly correlated with dietary restraint ( $r = 0.30$ ;  $p < 0.05$ ). There was a positive and significant correlation between the trigger *I felt stressed/anxious/sad* and STAI-S ( $r = 0.36$ ;  $p < 0.01$ ), STAI-T ( $r = 0.32$ ;  $p < 0.05$ ), and BDI ( $r = 0.25$ ;  $p < 0.05$ ). There also were some significant correlations between anxiety/depression and different descriptors and sensory modalities of the favourite food imagining experience, which are shown in table IV. Taking into account the coping strategies, these showed no significant correlations neither with the variables associated with the craving experience nor with those variables related with the favourite food induction. Nevertheless, some correlations were found considering trait measures as dietary restraint and FCI. Thus, dietary restraint was negatively associated with social support ( $r = -0.42$ ;  $p < 0.01$ ), emotion-focused engagement ( $r = -0.39$ ;  $p < 0.01$ ) and engagement ( $r = -0.39$ ;  $p < 0.01$ ). Vice versa, dietary restraint was positively associated with social withdrawal ( $r = 0.30$ ;  $p < 0.01$ ). With respect to the scores on FCI, problem avoidance was associated with the third subscale of the FCI (*saturated fats/high calorie content —fast food—*) ( $r = 0.31$ ;  $p < 0.01$ ) and with FCI total score ( $r = 0.26$ ;  $p < 0.05$ ). Problem-focused disengagement was associated with

**Table IV**  
Correlations among anxiety/depression and descriptors/sensory modalities of the favourite food imagining experience

	BDI	STAI-S	STAI-T
<i>Descriptors</i>			
Eating it would feel very comforting right now	0.28*	0.37**	0.28*
Thinking how much better I would feel after I have eaten it	0.21	0.38**	0.20
I would feel more relaxed if I ate it	0.34**	0.50**	0.31*
I am visualizing it	0.31*	0.37**	0.20
I am trying to resist eating it	0.19	0.31*	0.18
I can hear myself eating it	0.21	0.27*	0.20
<i>Sensory modalities</i>			
I smelt the food	0.18	0.29*	0.21
I tasted the food	0.29*	0.33**	0.19
I felt the texture of the food in my mouth	0.44**	0.39**	0.38**

BDI: Beck Depression Inventory; STAI-S: State Trait Anxiety Inventory (State); STAI-T: State Trait Anxiety Inventory (Trait). \* $p < 0.05$ ; \*\* $p < 0.01$ .

that third subscale ( $r = 0.29$ ;  $p < 0.05$ ) and with FCI total score ( $r = 0.30$ ;  $p < 0.01$ ). Finally, disengagement also was associated with the third subscale ( $r = 0.33$ ;  $p < 0.01$ ) and with FCI total score ( $r = 0.25$ ;  $p < 0.05$ ).

## Discussion

Considering the description of craved foods, the fact that sweet foods were the most craved ones confirms other previous findings. The same applies in the case of chocolate as the most craved specific food, women being those who prefer this specific food.<sup>1,11,12,23</sup> Reasons based on sociocultural bases have been given in order to explain this preference, which is supported by the results of different cross-cultural studies among Western countries.<sup>35</sup>

During the food craving experience, thoughts and images were the most highly rated triggers, confirming previous results.<sup>12</sup> Moreover, those images were correlated with craving intensity. Taking into account that the experimental craving experience was a measure of state food cravings, our results show that this state is, to some extent, correlated with measures of trait food cravings. Seven out of the 14 triggers were significantly correlated with the total score on the FCI, this indicating that it is hardly difficult to separate the state and trait food craving experiences. On the other hand it seems that different triggers are correlated with specific trait food cravings. Thus, imagining the smell/taste of the food, picturing oneself having the food or being busy were correlated with the craving for *single sugars/trans fats*; other triggers like *I heard it, I smell it or Other things I was thinking about reminded me of it* were correlated with the craving for *complex carbohydrates/proteins*; and finally, to see the food or feeling happy were correlated with the craving for *saturated fats/high calorie content—fast food—*.

With respect to sensory modalities, visualizing and imagining the taste of the food caused the most craving intensity, confirming previous results.<sup>12</sup> Imagining the taste of the food and the texture of the food in the mouth were highly correlated with the vividness of the experience. Finally visualizing the food, imagining the taste and smell of the food, and imagining the texture of the food in the mouth were highly correlated with the urge to eat the food. To some extent, these relations among imagining, vividness of the experience, and craving were previously reported.<sup>26</sup>

Dietary restraint does not seem to be specifically related to the state craving, except in case of the trigger *I felt stressed/anxious/sad*. This general absence of association between dietary restraint and state craving has been previously reported.<sup>12</sup> Apart from methodological differences among studies, the distinction between state craving and trait craving could explain different results with respect to the link between food craving and dietary restraint. In fact, a relationship between trait craving and dietary restraint has been

reported,<sup>12</sup> that association not being confirmed in the current study. Based on the current results, feelings of stress, anxiety or sadness may be associated with state craving. Thus, these negative feelings might be correlated with single episodes of craving more than with global measures of food craving.

Considering the general imaging ability, this general ability was found correlated with the triggers, descriptors and sensory modalities taken into account in this study. The same applies to the different modalities considered in the assessment of imaging ability. Once again these results confirm those reported previously as well as the fact that the imagery is a key element of craving, providing the subjective experience and mediating much of the associated disruption of concurrent cognition as it has been noted by the Elaborated Intrusion theory.<sup>2,12</sup>

The most novel point about the current study is the analysis of the role of some psychological variables. Having in mind the results, state anxiety is the main variable associated with the descriptors and sensory modalities during the favourite food imagining experience. The descriptor *I would feel more relaxed if I ate it* is also significantly associated with symptoms of depression, and *to feel the texture of the food in the mouth* was associated with symptoms of depression too. The association of the food craving with different psychopathological syndromes and eating behaviour disorders has been widely reported.<sup>5,36</sup> In addition, high rates of psychopathology have been found in binge eaters and bulimia nervosa.<sup>22</sup>

The role of coping strategies appears to be more related with trait measures as dietary restraint and FCI. Considering the characteristic of personality, a previous study found that cravers have higher level of harm avoidance and lower level of self-directedness and persistence than controls. Moreover, food cravers who binge were characterized by a high level of dietary restraint and low self-directedness, existing true differences between cravers who do and do not binge.<sup>5</sup> The current results show that dietary restraint was negatively associated with social support, emotion-focused engagement. Vice versa, dietary restraint was positively associated with social withdrawal. These results indicate an association between dietary restraint and negative coping strategies. On the other hand a positive association between negative coping strategies and trait food craving was found. Summarizing, negative coping strategies are related to dietary restraint and trait food craving. In fact, inadequate coping skills have been found among binge eaters<sup>37</sup> and different subgroups of patients with eating disorders have been reported with regards to the characteristics of personality and coping strategies.<sup>38</sup>

The current results firstly confirm the role of mental imagery in the food craving experience with all the different sensory modalities involved to some extent. The correlation found between variables of state and trait food craving shows the difficulty to separate the two facets of the craving experience. Feelings of stress,

anxiety or sadness may be associated with state craving. Finally, the current study shows the role of anxiety during the food imagining experience, the association between the dietary restraint and negative coping strategies, and the link between those negative strategies and trait food craving.

This study has a number of limitations, the first with respect to the sample, which is a specific one comprising of only undergraduate students. Future studies should be included other type of non-clinical participants as well as patients with eating behaviour disorders (e.g., binge eaters). Due the relationship between the phenomenology of food craving and symptoms of anxiety and/or depression, other type of disorders should also be included in future designs. In order to analyse the theoretical, but controversial, relationship between food craving and eating behaviour it would be appropriate to include some behavioural measures besides the analysis of state and trait cravings. The influence of coping strategies, anxiety and depression on the relationship between relationship between mental imagery and food craving need to be better explored in future studies in order to clarify that role as mediator or modulator by means of tests of mediation.

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