Nutrición Hospitalaria

Nutr Hosp. 2014;29(5):1188-1195
ISSN 0212-1611 • CODEN NUHOEQ
S.V.R. 318

Original / *Otros*

Sweets and fats tasting in patients with anorexia nervosa; the role of the thought-shape fusion cognitive distortion

José Manuel Monje Moreno[1], Leticia Álvarez Amor[2], Inmaculada Ruiz-Prieto[2], Patricia Bolaños-Ríos[2] and Ignacio Jáuregui-Lobera[1,2]

[1]*Universidad Pablo de Olavide. Sevilla.* [2]*Instituto de Ciencias de Conducta. Sevilla. Spain.*

Abstract

Introduction: **It has been found that the olfactory-gustatory function is altered in patients with eating disorders, with an impairment affecting the perception of olfactory and gustatory stimuli.**

Objective: **The aim was to explore the subjective reactivity after the exposure and tasting of foods with different gradient of sweetness and different fats textures. In addition, changes in the thought-shape fusion (TSF) cognitive distortion were assessed after tasting those different presentations as well as the correlations between the initial scores on TSF-Questionnaire (TSF-Q) and the different responses after that tasting.**

Method: **A total of 15 healthy controls and 23 outpatients with anorexia nervosa underwent two sessions of tasting (sweets with different gradient of sweetness and fats with different textures) and they filled several questionnaires (pre- and post-tasting) to measure their responses after tasting.**

Results: **Participants showed less "self-control" after tasting sweets. The score on TSF-Q increased significantly after the sweets tasting in the patients group. Patients had the worst response after tasting presentations with more quantity of glucose (less gradient of sweetness) than after tasting those with more amount of sucrose (much more sweetness). With respect to the fats, patients showed the worst reaction after tasting the most unfamiliar texture. Pre fats tasting TSF-Q scores correlated significantly with all responses in the patients group.**

Discussion: **Both psychological and biological (e.g. genetic) factors could be involved in the reactions of patients with anorexia nervosa after tasting sweets and fats.**

(*Nutr Hosp.* 2014;29:1188-1195)

DOI:10.3305/nh.2014.29.5.7384

Key words: *Taste responsiveness. Sweets taste. Fats taste. Thought-shape fusion. Anorexia nervosa.*

Correspondence: Ignacio Jáuregui-Lobera.
Universidad Pablo de Olavide. Sevilla.
E-mail: ijl@tcasevilla.com

Recibido: 27-II-2014.
Aceptado: 12-III-2014.

CATA DE DULCES Y GRASAS EN PACIENTES CON ANOREXIA NERVIOSA; EL PAPEL DE LA DISTORSIÓN COGNITIVA FUSIÓN PENSAMIENTO-FORMA

Resumen

Introducción: **Se ha encontrado que la función olfativa-gustativa está alterada en pacientes con trastornos de la alimentación, con una alteración que afecta la percepción de los estímulos olfativos y gustativos.**

Objetivo: **El propósito fue explorar la reactividad subjetiva tras la exposición y prueba de alimentos con distintos gradientes de dulzor y diferentes texturas grasas. Además, se evaluaron los cambios en la distorsión cognitiva de la fusión idea-forma (FIF) tras probar diferentes presentaciones así como las correlaciones entre las puntuaciones iniciales del Cuestionario FIF (C-FIF) y las distintas respuestas tras esa prueba.**

Método: **Un total de 15 controles sanos y 23 pacientes ambulatorios con anorexia nerviosa se sometieron a dos sesiones de pruebas (dulces con distintos grados de dulzor y grasas con distintas texturas) y rellenaron varios cuestionarios (pre y post-prueba) para medir sus respuestas tras la prueba.**

Resultados: **Los participantes mostraron menos "autocontrol" tras las pruebas con dulces. La puntuación del C-FIF-Q aumentó de forma significativa tras las pruebas con dulces en el grupo de pacientes. Los pacientes tuvieron una peor respuesta tras las pruebas con aquellos alimentos con mayor contenido en glucosa (menor gradiente de dulzor) que tras probar aquellos alimentos con una mayor cantidad de sucrosa (mucho más dulzor). Con respecto a las grasas, los pacientes mostraron una peor reacción tras probar la textura menos familiar. Las puntuaciones del C-FIF pre-prueba se correlacionaron significativamente con todas las respuestas en el grupo de pacientes.**

Discusión: **Tanto factores psicológicos como biológicos (p. ej., genéticos) podrían estar implicados en las reacciones de los pacientes con anorexia nerviosa tras las pruebas con dulces y grasas.**

(*Nutr Hosp.* 2014;29:1188-1195)

DOI:10.3305/nh.2014.29.5.7384

Palabras clave: *Respuesta al sabor. Cata de dulces. Cata de grasas. Fusión pensamiento-forma. Anorexia nerviosa.*

Introduction

It has been found that the olfactory-gustatory function is altered in patients with eating disorders (ED), with an impairment affecting the perception of olfactory and gustatory stimuli[1]. Patients with restrictive-type anorexia nervosa (AN) have shown significant lower pleasantness scores for pleasant taste stimuli compared with controls, these differences being greatest for a lower concentration of sucrose, umami and sodium chloride[2]. Prospective studies have reported that compared to healthy controls and bulimic patients, anorectic patients show lowered olfactory and gustatory sensitivities that may be improved by increasing body mass index and decreasing eating pathology during the treatment[3]. Considering taste as a hereditary trait, the number of fungiform papillae of the tongue has been explored in anorectic patients. As a result, a reduced number of papillae has been associated with a decreased 6-n-propylthiouracil sensitivity. In this regard the variation of the papillae number and 6-n-propylthiouracil sensitivity might influence the pathophysiology of eating behaviour and taste perception, and consequently this might be involved in the development of ED[4].

Changes in taste responsiveness (sweet, salty, sour and bitter tastes) have been assessed during behaviour therapy of anorectic patients. As result, lower taste responsiveness at admission has been observed when compared to controls. That responsiveness was found out to be improved significantly over the course of treatment and that improvement occurred prior to increase in body weight. In fact no significant correlation was noted between weight gain and improvement in taste responsiveness. Those patients who reached 1,600 kcal/day earlier showed more rapid improvements in taste responsiveness, these results suggesting that decreased taste responsiveness in AN patients could rapidly improve and such early improvement might result in better progression of treatment[5].

Despite having been reported different alterations with respect to the taste sensitiveness and to some extent in the olfactory-gustatory function, the topic seems to remain controversial. In fact, a recent study suggests that individuals with AN do not have a markedly greater ability to taste fat than controls, so fat avoidance would be likely based primarily on cognitive factors. In this case, a taste case was performed by means of three different presentations of cream cheese (fat-free, low fat and regular). There were not observed main effects of the fat content but a significant main effect of the trial was found out. The post hoc findings of this study suggested that with repeated exposure (i.e., over three trials), AN patients' ratings of the fat-free cream cheese improved. Reasons for this were unclear, but authors stated that personal experience with fat-free products would had made it easier for these patients to recognize some taste or sensory characteristics associated with a fat-free food[6].

The relationship between specific thoughts related to food and feelings related to body image have been described as thought-shape fusion (TSF)[7]. In a previous study we explored the subjective reactivity and the TSF cognitive distortion after thinking about eating fattening foods, as opposed to anxiety-inducing thoughts in general[8]. As far as we know, there are no studies based on the subjective reactivity and the TSF distortion after tasting different gradients of sweetness and fat textures.

The aim of the current study was to explore the subjective reactivity after the exposure and tasting of foods with different gradient of sweetness (cupcakes) and different textures (olive oil in its natural state, olive oil as mayonnaise and olive oil as meringue). In addition, changes in the TSF cognitive distortion were assessed after tasting those different presentations as well as the correlations between the initial scores on TSF-Q and the different responses after that tasting.

Method

Participants

The sample comprised of 48 females, 15 healthy controls (students recruited from the Pablo de Olavide University, Seville) and 23 outpatients with anorexia nervosa (AN). These outpatients were receiving treatment in the ED Unit of the Behaviour Sciences Institute in Seville and they fulfilled the DSM IV-TR[9] criteria for AN. The sample mean age was 21.34 ± 4.96. There was not significant difference between the two subsamples. With respect to the students, they did not have any psychiatric history, this being assessed by means of a brief questionnaire at the moment of obtaining the informed consent.

Materials

Meals

1. Sweets: the idea was to offer three cupcakes with a gradient of sweetness without changing significantly the texture and the calorie content.
2. Fats: The idea was to offer three preparations using the same amount of extra virgin olive oil (EVOO) but with three different textures. In order to use a common way to take the EVOO we chose the presentation of "bread with oil and tomato", a usual breakfast in our Spanish context. Initially, four possible presentations were designed: a) The oil without any treatment; b) The oil emulsified as mayonnaise; c) The oil as a foam or meringue type mouse and d) The oil as solid form like a typical Christmas sweet ("polvorón"). After a pilot test, the latter form was removed due to difficulties to maintain it for several hours

(keeping in mind that most of the tastings were made in a place other than where preparations were ellaborated) and because it was a presentation served on top of bread, it produced an unfortunate marriage.

Ingredients

1. Sweets: All data will be expressed in g, except the eggs, which were classified in units (having a "L" category: 63-73 g). Flour with a chemical propellant (added in order to obtain more homogeneous repetitions) was used. "Bizcochona" flour (HARIMSA brand) was used. The sugar was a refined beet one ("White Sugar Azucarera" brand). Glucose powder was used ("Sosa" brand). Natural unsweetened yogurt ("Danone" brand) was chosen. As a result, the three preparations were:

Ingredients	Preparation 1 (P1) (No glucose)	Preparation 2 (P2) (Glucose 40 g)	Preparation 3 (P3) (Glucose 80 g)
Flour	150	150	150
Sucrose	167	127	87
Glucose	0	40	80
Natural yogurt	83	83	83
Lemon zest	3.5	3.5	3.5
EVOO	43	43	43
Eggs (L)	2	2	2

2. Fats: The oil was the Arbequina EVOO. For the different presentations the following products were used: a) Canned crushed tomatoes ("Orlando" brand); b) Salt; c) "Gelespesa" thickener gel based on xanthan gum ("Sosa" brand); d) A emulsifier paste based on mono- and diglycerides of fatty acid esters of glycerol ("Sosa" brand); e) Powder of albumin ("Sosa" brand). The emulsifier paste comprised of water, mono- and diglycerides of fatty acids (E471), polyglycerol esters (E475), oxyethylenated sorbitan esters (E435), sorbitol, dextrose, citric acid (E330) and sorbic acid (E200). The thickener gel consisted of maltodextrin and xanthan gum (E415). For the presentation, "BIMBO" brand bread without crust was used.

Preparation

1. Sweets (cupcakes): The ingredients were weighed with a precision balance (Tanita KD320WH33; 0.1 g accuracy). Eggs were beaten with a hand mixer and sugars (table sugar alone or mixed with glucose) were incorporated. The mixture was beaten until smooth and whitish mixture was achieved. Yogurt, oil and lemon zest were incorporated and beaten until becoming homogeneous. Flour was gradually incorporated while beating it until getting a homogeneous mixture. A plum cake-type silicon mold was filled with the mixture. It was baked for 33 minutes at 175 °C with forced air and with the heat source from both above and below (an oven of forced convection Teka mark was used). After cooling, the cupcakes, they were taken out of the mold and cut into portions of 15 g (with similar size and always with one of its edges with bark) thus giving it a look as consistent as possible.
The reason to use mixed sugar (sucrose) and glucose was that sugar not only adds flavour but also influences the physical characteristics (appearance, texture, etc.) of the final preparation. Glucose, having the same caloric content than sucrose, has a lower sweetening power than sucrose (about 30% lower). With mixtures of sucrose/glucose isocaloric cupcakes are obtained, containing the same amount of sugar but with less sweetness (the smaller the quantity of sucrose is, the lower the sweetness will be). With this we also tried to minimize the differences in texture and appearance they may have, although there may remain some minor differences.
2. Fats: All textures of oil were served on homogeneous 5 g-slices of bread without crust ("BIMBO" brand). In all cases the amounts of tomato and oil were the same (1.2 g), regardless the total weight of the preparation. The three presentations were:

   a) Bread with oil and tomato: 1.2 g of Arbequina EVOO, 1.2 g of canned crushed tomatoes and salt (this mixture is made using 50 g of tomato and 0.5 grams of salt), and 5 g of bread without crust.
   b) Bread with tomato mayonnaise: The tomato mayonnaise comprised of 70 g of Arbequina EVOO, 70 g of canned crashed tomatoes, 1.2 g of thickener gel, 1.2 g of emulsifier paste and 0.7 g of salt. The tomato, salt, emulsifier and paste were mixed by means of a hand blender. The oil was added gradually until getting the mayonnaise texture. Finally, 2.46 g of the tomato mayonnaise were placed on the 5 g-portions of white bread.
   c) Bread with olive oil and tomato meringue: The tomato meringue comprised of 100 g of Arbequina EVOO, 100 g of canned crashed tomatoes, 18 g of albumin powder and 1 g of salt. Oil, tomato, salt and albumin were mixed and then the mixture was placed in a bowl of a food processor (a Kitchen Aid robot). It was beaten by means of special rods to mount until a meringue texture was reached (8/9 power). Finally, 2.62 g of tomato meringue were placed on the 5 g-portions of white bread.

Instruments

The following scales/questionnaires were applied:

1. Subjective Reactivity to the exposure of food: this was assessed by means of a list of adjectives (7 positive and 7 negative) modified from Rodriguez (2005)[10]. For each adjective, participants rated their feelings from 0 to 100. The positive adjectives were self-controlled, self-assured, happy, valuable, motivated, satisfied and relaxed. On the contrary, the negative adjectives were depressed, embarrassed, anxious, overwhelmed, vulnerable, guilty and angry.
2. Ten cm-Visual Analogue Scales (VAS): This self-report instrument gathers information about mood, anxiety, likelihood of weight gain, feelings of fatness, and moral wrong-doing, all of them marked from 0 to 10 (0 = the lowest level on each variable, 10 = the highest level on each variable). These scales have been used in previous studies[8,11,12].
3. Thought Shape Fusion questionnaire (TSF-Q): It is a 34-item, self-report questionnaire, which measures the fusion between thought and body shape or image. TSF-Q comprises of two sections, identified by its authors as conceptual (TSF conceptual) and interpretative (TSF interpretative). The Spanish version was used, which has shown adequate psychometric properties[7,13,14].
4. The Positive and Negative Affect Schedule (PANAS): This is a 20-item self-report questionnaire to measure affectivity by means of two dimensions (positive and negative affect). The Spanish version was applied, which has shown adequate psychometric properties[15].

Procedure

Foods were prepared at the kitchen of the Nutrition and Bromatology Area (Pablo de Olavide University, Seville). The experiment was run at that kitchen in the case of students. In the case of patients, they underwent the experiment in the Behaviour Sciences Institute. In both cases a Nutritionist was in charge to conduct the experiment. The experiment comprised of two different sessions: a) Sweet presentations tasting and b) Fat presentations tasting. During the sweet tasting, participants were invited to try the three above-mentioned presentations (1, 2 and 3). In the case of the fat tasting, participants tried bread with oil and tomato, bread with tomato mayonnaise and bread with olive oil and tomato meringue. Before each session (one for the sweets and another for the fats) participants filled the list of adjectives, the TSF-Q and the PANAS. Immediately after each presentation (three for the sweets and three for the fats) they responded to the VAS. Finally, at the end of each session (one for the sweets and another for the fats) they filled again the list of adjectives, the TSF-Q and the PANAS.

In the case of patients, individual sessions were held, coinciding with their regular appointments. In the case of students, individual sessions were held after previous appointment specifically established for the experiment. After obtaining informed consent for the study, the participants completed the questionnaires in individual sessions with no time limit; this was done in the therapeutic context (patients) or in the University (students) in similar conditions and with the nutritionist present during the sessions. That nutritionist gave participants instructions both about how to complete the questionnaires and how to proceed during food presentations.. After making sure that they had understood him, the experiment started. All participants (both clinical participants and students) volunteered to take part in the study and none of them received any kind of recompense for completing the experiment. In order to counterbalance the possible carryover effects, the three presentations in each case (sweets and fats) were randomly assigned.

The study protocol was approved by the institution review board of the Behaviour Sciences Institute (Seville, Spain).

Data analysis

All data were analysed by means of the statistical package, SPSS 17.0. (SPSS, Inc.)[16]. Differences were considered significant for $p < 0.05$. Values were expressed as mean values (M) with standard deviation (SD). The variables "magnitude of change" (Post-tasting minus Pre-tasting) were calculated for several variables and the normality of these transformed variables was checked by the Kolmogorov-Smirnov test. As a result, the parametric Student's *t*-test was applied (despite the small sample size, *t*-test is considered as appropriate when variables fit the normal distribution) for both dependent (intra-group differences) and independent samples (inter-groups differences). In the case of correlations, the Pearson's *r* coefficient was calculated.

Results

Healthy control group

There were not any significant differences pre- and post-tasting of sweet presentations with respect to the VAS. As far as the adjectives were concerned, a significant difference was found in the case of "self-controlled" (pre-tasting = 67.33, post-tasting = 56.00; $p < 0.05$). Taking into account the TSF-Q and the PANAS, no differences were found.

The fats tasting revealed a significant difference in the VAS related to the "likelihood of weight gain" with the highest score obtained after tasting the presentation "oil

with bread and tomato" ($p < 0.05$). The fats tasting also yielded a significant difference in the adjective "guilty" (pre-tasting = 14, post-tasting = 20; $p < 0.05$). Considering the TSF-Q, the difference was not statistically significant (pre-tasting = 15.53, post-tasting = 19.07). There were not any significant differences respecting the PANAS.

Patients group

Respecting to the sweets tasting, there were found some significant differences in the case of VAS. While the score on "mood" decreased (P1 = 5.40; P2 = 4.88; P3 = 4.20; $p < 0.05$), the scores on "likelihood of weight gain" (P1 = 1.81; P2 = 2.53; P3 = 2.86), "feeling of fatness" (P1 = 1.91; P2 = 2.56; P3 = 2.83) and "moral wrong doing" (P1 = 2.47; P2 = 2.93; P3 = 2.98) increased ($p < 0.0001$, $p < 0.05$ and $p < 0.05$, respectively). In the case of the adjectives, the score on "self-controlled" decreased significantly (35.30 *vs* 23.52; $p < 0.05$).

There were not any significant differences with respect to the PANAS. With regards to TSF-Q, a significant difference was obtained (pre-tasting = 44.78, post-tasting = 56.30; $p < 0.05$)

The fats tasting did not reveal any differences considering the VAS. The score on "self-controlled" increased (22.17 *vs* 27.61) during the tasting with the highest score after taking the bread with olive oil and tomato meringue. Finally there were not significant differences with regards to TSF-Q and PANAS.

Patients group vs *Control group*

Tables I and II show the differences between the two groups after sweets and fats tasting. In order to analyse the magnitude of change with respect to the TSF-Q and PANAS, the variable "post minus pre" was obtained for TSF-Q, PANAS positive and PANAS negative. As a result, the magnitude of change was significantly different in the case of TSF-Q after sweets tasting: while in the control group the mean change was -1.4 (that means that TSF-Q score decreased), in the patients group the mean change was + 11.52 (the TSF-Q score increased clearly). No significant differences were found with respect to TSF-Q after fats tasting and PANAS (sweets and fats) considering the magnitude of change.

Table I
Differences between CG and PG after sweets tasting (M ± SD)

	Control group (CG)			*Patients group (PG)*		
	Post-P1	*Post-P2*	*Post-P3*	*Post-P1*	*Post-P2*	*Post-P3*
Mood	8.16 ± 1.02**	8.04 ± 1.22**	8.44 ± 1.04**	5.40 ±1.67**	4.88 ± 1.03**	4.20 ± 1.22**
Anxiety	2.21 ± 0.83	2.09 ± 1.02	2.25 ± 0.97	3.05 ± 1.03	3.67 ± 1.44	3.90 ± 1.03
Guilty	1.03 ± 0.19	1.10 ± 0.77*	1.15 ± 0.88**	2.48 ± 0.98	3.40 ± 1.07*	3.77 ± 1.34**
Likelihood weight gain	1.65 ± 1.03	1.32 ± 0.42	1.27 ± 0.08*	1.81 ± 0.99	2.53 ± 1.01	2.86 ± 0.98*
Feeling fatness	1.78 ± 0.98	1.10 ± 0.21	0.92 ± 0.11*	1.90 ± 0.67	2.56 ± 0.96	2.83 ± 0.78*
Moral wrong doing	0.41 ± 0.11	0.44 ± 0.09**	0.48 ± 0.12*	2.47 ± 1.03	2.93 ± 0.66**	2.99 ± 1.01*

* $p < 0.05$.
** $p < 0.01$.
P1-P2-P3 = Preparations/presentations 1-2-3.

Table II
Differences between CG and PG after fats tasting (M ± SD)

	Control group (CG)			*Patients group (PG)*		
	Post-O	*Post-M*	*Post-Me*	*Post-O*	*Post-M*	*Post-Me*
Mood	8.38 ± 1.07**	8.37 ± 0.99**	8.37 ± 0.65**	4.95 ± 1.21**	4.40 ± 1.07**	4.26 ± 1.20**
Anxiety	1.32 ± 0.76	1.27 ± 0.99	1.22 ± 0.21	2.53 ± 0.87	2.63 ± 0.76	2.76 ± 1.01
Guilty	0.97 ± 0.11	0.90 ± 0.22*	0.79 ± 0.31*	2.36 ± 0.23	2.34 ± 0.89*	2.62 ± 1.10*
Likelihood weight gain	1.21 ± 0.17	1.00 ± 0.32	0.95 ± 0.43*	1.65 ± 0.98	1.91 ± 0.12	2.23 ± 0.75*
Feeling fatness	1.12 ± 0.45	0.98 ± 0.55	1.00 ± 0.23*	1.97 ± 0.76	2.00 ± 0.55	2.52 ± 0.77*
Moral wrong doing	0.28 ± 0.02**	0.33 ± 0.08**	0.23 ± 0.07**	1.93 ± 0.89**	2.00 ± 0.91**	2.44 ± 0.32**

* $p < 0,05$.
** $p < 0.01$.
O = Oil.
M = Mayonnaise.
Me = Meringue.

Correlations between the score on TSF-Q pre-tasting and the results after tasting

In the control group, pre sweets tasting TSF-Q correlated significantly with "guilty" and "likelihood of weight gain" after sweets tasting P1 (0.63 and 0.55; $p < 0.01$) and P3 (0.60 and 0.66; $p < 0.01$). Pre sweets tasting TSF-Q also correlated significantly with post sweets tasting TSF-Q (0.92; $p < 0.01$) and with post sweets tasting PANAS positive (-0.61; $p < 0.01$). Pre fats tasting TSF-Q correlated with "likelihood of weight gain" and "feeling fatness" after oil tasting (0.53 and 0.58; $p < 0.01$) and with "feeling fatness" after mayonnaise tasting (0.78; $p < 0.01$). Again pre fats tasting TSF-Q correlated with post fats tasting TSF-Q (0.98; $p < 0.01$) and with post fats tasting PANAS positive (-0.71; $p < 0.01$).

The correlations in the patients group with respect to the VAS are shown in table III. In addition, pre fats tasting TSF-Q correlated significantly with post fats tasting PANAS negative (-0.56; $p < 0.01$) and with post fats tasting TSF-Q (0.99; $p < 0.01$).

Discussion

According to the results, the participants of both the control group and the patients group showed less "self-control" after tasting sweets. This result confirms other similar findings related with the fact that sweet foods are the most craved[17-19]. In the laboratory context, Martin et al., have reported an association between food cravings and consumption of specific foods in a taste test[20]. With respect to the sweets, patients showed a decrease of the "mood" state as well as an increase of "likelihood of weight gain", "feeling of fatness" and "moral wrong doing" after tasting sweets. In a previous study[8] a TSF-induction condition caused more "guilt", more "feelings of fatness", more "likelihood of weight gain", and higher degree of "moral wrong doing" compared with participants in both anxiety and control induction conditions. The results of the current study are based not on thoughts related with food but on an experimental food tasting. The TSF cognitive distortion emerges not only after thinking about eating some foods but after tasting them, thus possibly closing a pathological circle which maintains the core symptoms of the anorexia nervosa. In fact, in this experiment the score on TSF-Q increased significantly after the sweets tasting in the patients group. In addition, the pre sweets tasting TSF-Q score correlated significantly with all VAS scores (negatively with "mood" and positively with the rest of scales). After fats tasting the participants of the control group felt more "guilty" than prior, which is a result coherent with other data previously reported[12]. This was not the case in the patients group, in which the participants showed less "self-control" after tasting "bread with olive oil and tomato meringue". Paradoxically, while patients did not change their scores on the VAS scales after fats tasting, the participants of the control group showed an increase in the "likelihood of weight gain" after tasting "olive oil with bread and tomato". The texture of these presentations seems to be relevant regarding the participants' reaction. The patients' less control after tasting "bread with olive oil and tomato meringue" could be explained by the unfamiliarity of this presentation, which is not usual in their usual diet. While "olive oil with bread and tomato" is a normal breakfast in Spain, especially in Andalucía, the "meringue" presentation is rare in our context. During the patients' nutritional treatment "olive oil with bread and tomato" becomes familiar with a progressive reduction of fear regarding this presentation. In the case of the "meringue", this form of fat intake remains unusual so it is something new and a possible reason for the feeling of less control. In fact, the tendency to dislike some high-fat foods in anorexia nervosa patients has been reported[21]. The increasing of "likelihood of weight gain" after tasting "olive oil with bread and tomato" is not surprising taking into account the irrational food beliefs widely spread in Western populations. In this regard, the healthy/unhealthy categorization of foods leads to prefer/avoid certain foods and distinguishing between guiltless and guilty eating. A variable related to guilty eating is the calorie content and the fat content of the food and the likelihood of

Table III
Correlations (Pearson's r coefficient) between pre TSF-Q and VAS after sweets and fats tasting in patients group

	Post-P1	*Post-P2*	*Post-P3*	*Post-O*	*Post-M*	*Post-M3*
Mood	-0.49*	-0.52*	-0.53**	-0.54**	-0.46*	-0.64**
Anxiety	0.43*	0.45*	0.42*	0.56**	0.53**	0.46*
Guilty	0.53**	0.55**	0.69**	0.63**	0.65**	0.50*
Likelihood weight gain	0.45*	0.52*	0.51*	0.54**	0.49*	0.42*
Feeling fatness	0,47*	0.50*	0.53**	0.60**	0.51*	0.43*
Moral wrong doing	0,58**	0.57**	0.59**	0.63**	0.54**	0.47*

* $p < 0.05$.
** $p < 0.01$.
O = Oil.
M = Mayonnaise.
Me = Meringue.

weight gain after eating that type of high-calorie/high-fat food[22]. Again the TSF cognitive distortion is clearly involved in the results. Despite not having observed a significant difference pre fats tasting/post fat tasting with respect to the TSF-Q, either in the control group or in the patients group, the pre fats tasting TSF-Q scores correlated significantly with all VAS scores in the patients group.

Besides the psychological facets of the participants' responses it must be noted some results considering the gustatory function in these patients. While the control group's participants showed higher "likelihood of weight gain" and more "feeling fatness" scores after tasting the cupcake with the highest gradient of sweetness (P1), patients showed a different response: the more amount of glucose the presentations had the higher scores were obtained on the previously mentioned two VAS scales. Due to the proportions glucose/sucrose, the result indicates that patients have a worse response after tasting more quantity of glucose (less gradient of sweetness) than after tasting more amount of sucrose (much more sweetness). Several methods for measuring sweet taste preferences have been developed but the results seem to be different depending on the technique. Thus Holt et al.[23] found that liking for sweetness in an aqueous solution did not predict the degree of liking for sweetness in orange juice, custard or shortbread biscuits. Approximately half of the variation in liking for sweet solution and liking and use-frequency of sweet foods is explained by genetic factors, whereas the rest of variation is due to environmental factors[24]. In an experimental study it has been shown that leptin selectively suppresses gustatory neural and behavioural responses to sweet compounds without affecting responses to other taste stimuli. In addition it seems that taste recognition threshold for sweets compounds is independent of changes in blood glucose[25]. We have currently no persuasive explanation for this result considering that a lower level of leptin should be correlated with lower taste recognition threshold for sweets, which was not the case.

Taste perception is highly related to functional metabolic status and body adiposity, so it has been reported that calorie restriction could alter the sweet taste perceptions[26]. In order to explore whether patients recovered from anorexia nervosa had an abnormal physiological response to sugar, a pleasant taste, or water, a neutral contrast taste, in the primary or in secondary taste-modulation cortical regions, Wagner et al.[27] designed a study based on fMRI. As a result, authors reported that participants recovered from anorexia nervosa had disturbances of gustatory processing in the central nervous system. They had a significantly reduced fMRI signal response to the blind administration of sucrose or water in the insula, anterior cingulate and striatal regions. In addition individuals failed to show any relationship in these regions to self-reporting of pleasant response to a sucrose taste. Comparing anorexia nervosa patients with those suffering from bulimia nervosa some authors have reported that bulimic patients had an exaggerated anterior ventral striatum response for the cream/water contrast in comparison to anorectic patients[28]. Operndorfer et al.[29] reported that women recovered from anorexia nervosa had significantly diminished and women recovered from bulimia nervosa had significantly elevated hemodynamic response to tastes of sucrose in the right anterior insula. Anterior insula response to sucrose compared with sucralose was exaggerated (lower in patients recovered from anorexia nervosa and higher in women recovered from bulimia nervosa). These altered insula responses have been suggested to be linked to disgust sensitivity[30]. Finally, animal models of activity-based anorexia suggest that a history of anorexia could enhance food avoidance learning and retard its extinction in female rats[31].

In the case of fats tasting the control group did not show any significant differences based on the different textures. On the contrary, patients showed the worst responses after tasting the "meringue" form and the best after tasting the "olive oil with bread and tomato". That indicates that anorectic patients could exhibit different responses depending on fat presentations (textures). In fact these patients seem not to have greater ability to taste fat content than healthy individuals[6]. It seems that their responses with respect to the fats are based more on the texture than on the fat content per se, despite having observed that these patients tend to associate calories with fat content[21].

From a clinical point of view, it has been reported that taste responsiveness in patients with anorexia nervosa improves with the treatment prior to increase the body weight[5]. Apart from the origin of some gustatory alterations in patients with anorexia nervosa, the problem remains controversial in general. In fact some authors have reported that there is no systematic sensory-perceptual deficits in these patients, and specifically, not in gustatory function. The differences observed might be due to fear of food-related stimuli or comorbidity[32].

The present study has some limitations. With respect to the patients, the sample did not comprise of either cases of bulimia nervosa or other type of eating disorders. Bearing in mind some previous studies, the inclusion of different types of patients would be interesting. Consequently a bigger sample size would be necessary. Another point to be considered in future studies would be the different period of time under treatment, this being a variable that was not considered in here. Whether the worst reaction after tasting more concentration of glucose (instead of sucrose) is due to a special sensitivity or not should be carried out in another study. May be that the fact of being something different (so unfamiliar) would have been the reason for that reaction. The specific associations learnt by the participants of the control group during the period of time of their illness were not taken into account and they might be a variable interesting to be considered in a future line of study. Besides these limitations, the present study has some strengths. First of all the use

of habitual foods (olive oil, tomato, bread, cupcakes), which is not the case in other studies based on different products (or different dilutions, etc.) a bit less familiar in our context. With respect to the control group, the participants had not special knowledge of nutrition and had not participated in similar studies. The use of different textures for the same calorie content would be a limitation but at the same time is a clear strength due to the fact that patients normally eat different textures (foods and meals) and not pure tastes. In this regard this study shows a naturalistic approach to the problem.

References

1. Dazzi F, Nitto SD, Zambetti G, Loriedo C, Ciofalo A. Alterations of the olfactory-gustatory functions in patients with eating disorders. *Eur Eat Disord Rev* 2013; 21: 382-5.
2. Szalay C, Abrahám I, Papp S, Takács G, Lukáts B, Gáti A et al. Taste reactivity deficit in anorexia nervosa. *Psychiatry Clin Neurosci* 2010; 64: 403-7.
3. Aschenbrenner K, Scholze N, Joraschky P, Hummel T. Gustatory and olfactory sensitivity in patients with anorexia and bulimia in the course of treatment. *J Psychiatr Res* 2008; 43: 129-37.
4. Wöckel L, Hummel T, Zepf FD, Jacob A, Poustka F. Changed taste perception in patients with eating disorders. *Z Kinder Jugendpsychiatr Psychother* 2007; 35: 423-34.
5. Nozoe S, Masuda A, Naruo T, Soejima Y, Nagai N, Tanaka H. Changes in taste responsiveness in patients with anorexia nervosa during behavior therapy. *Physiol Behav* 1996; 59: 549-53.
6. Schebendach JE, Klein DA, Mayer LE, Devlin MJ, Attia E, Walsh BT. Assessment of fat taste in individuals with and without anorexia nervosa. *Int J Eat Disord* 2014; 47: 215-8.
7. Shafran R, Teachman BA, Kerry S, Rachman S. A cognitive distortion associated with eating disorders: Thought-shape fusion. *Br J Clin Psychol* 1999; 38: 167-79.
8. Jáuregui-Lobera I, Santed MA, Bolaños Ríos P, Ruiz Prieto I, Santiago Fernández MJ, Garrido Casals O. Experimental induction of thought-shape fusion in eating disorder patients: the role of coping strategies. *Nutr Hosp* 2011; 26: 1402-11.
9. American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorders: DSM IV-TR. Washington DC: American Psychiatric Association; 2000.
10. Rodríguez S. Ansia por la comida y bulimia nerviosa: Mecanismos psicofisiológicos. Tesis Doctoral. Granada: Editorial Universidad de Granada; 2005.
11. Jáuregui-Lobera I, Santed MA, Bolaños Ríos P. Impact of functional dyspepsia on quality of life in eating disorder patients: the role of thought-shape fusion. *Nutr Hosp* 2011; 26: 1363-71.
12. Baeza García A. Inducción experimental al food craving. *Trastornos Conduct Aliment* 2012; 15: 1663-90.
13. Shafran R, Robinson P. Thought-shape fusion in eating disorders. *Br J Clin Psychol* 2004; 43: 399-407.
14. Jáuregui-Lobera I, Santed MA, Shafran R, Santiago MJ, Estébanez S. Psychometric properties of the Spanish version of the Thougth-Shape Fusion Questionnaire. *Span J Psychol* 2012; 15: 410-23.
15. Sandín B, Chorot P, Lostao L, Joiner TE, Santed MA, Valiente RM. Escalas PANAS de afecto positive y negativo: validación factorial y convergencia transcultural. *Psicothema* 1999; 11: 37-51.
16. SPSS Inc. Statistical Package for Social Sciences (SPSS, v. 17.0). Chicago: SPSS Inc; 2007.
17. Tiggemann M, Kemps E. The phenomenology of food cravings: The role of mental imagery. *Appetite* 2005; 45: 305-13.
18. Jaúregui-Lobera I, Bolaños P, Carbonero R, Valero E. Psychometric properties of the Spanish version of Food Craving Inventory (FCI-SP). *Nutr Hosp* 2010; 25: 984-92.
19. Jáuregui-Lobera I, Bolaños-Ríos P, Valero E, Ruiz Prieto I. Induction of food craving experience: the role of mental imagery, dietary restraint, mood and coping strategies. *Nutr Hosp* 2012; 27: 1928-35.
20. Martin CK, O'Neil PM, Tollefson G, Greenway FL, White MA. The association between food cravings and consumption of specific foods in a laboratory taste test. *Appetite* 2008; 51: 324-6.
21. Drewnowski A, Pierce B, Halmi KA. Fat aversion in eating disorders. *Appetite* 1988; 10: 119-31.
22. Spence M, Livingstone MB, Hollywood LE, Gibney ER, O'Brien SA, Pourshahidi LK et al. A qualitative study of psychological, social and behavioral barriers to appropriate food portion size control. *Int J Behav Nutr Phys Act* 2013; 10: 92.
23. Holt SHA, Cobiac L, Beaumont-Smith NE, Easton K, Best DJ. Dietary habits and the perception and liking of sweetness among Australian and Malaysian students: a cross-cultural study. *Food Qual Pref* 2000; 11: 299-312.
24. Keskitalo K, Tuorila H, Spector TD, Cherkas LF, Knaapila A, Silventoinen K et al. Same genetic components underlie different measures of sweet taste preference. *Am J Clin Nutr* 2007; 86: 1663-9.
25. Nakamura Y, Sanematsu K, Ohta R, Shirosaki S, Koyano K, Nonaka K et al. Diurnal variation of human sweet taste recognition thresholds is correlated with plasma leptin levels. *Diabetes* 2008; 57: 2661-5.
26. Cai H, Daimon CM, Cong WN, Wang R, Chirdon P, de Cabo R et al. Longitudinal analysis of calorie restriction on rat taste bud morphology and expression of sweet taste modulators. *J Gerontol A Biol Sci Med Sci*. 2013 Sep 28. [Epub ahead of print]. doi: 10.1093/gerona/glt129.
27. Wagner A, Aizenstein H, Mazurkewicz L, Fudge J, Frank GK, Putnam K et al. Altered insula response to taste stimuli in individuals recovered from restricting-type anorexia nervosa. *Neuropsychopharmacology* 2008; 33: 513-23.
28. Radeloff D, Willmann K, Otto L, Lindner M, Putnam K, Leeuwen SV et al. High-fat taste challenge reveals altered striatal response in women recovered from bulimia nervosa: A pilot study. *World J Biol Psychiatry* 2012 Apr 30. [Epub ahead of print]. doi:10.3109/15622975.2012.671958.
29. Oberndorfer TA, Frank GK, Simmons AN, Wagner A, McCurdy D, Fudge JL et al. Altered insula response to sweet taste processing after recovery from anorexia and bulimia nervosa. *Am J Psychiatry* 2013; 170: 1143-51.
30. Vicario CM. Altered insula response to sweet taste processing in recovered anorexia and bulimia nervosa: a matter of disgust sensitivity? *Am J Psychiatry* 2013; 170: 1497.
31. Liang NC, Bello NT, Moran TH. Experience with activity based anorexia enhances conditioned taste aversion learning in rats. *Physiol Behav* 2011; 102: 51-7.
32. Goldzak-Kunik G, Friedman R, Spitz M, Sandler L, Leshem M. Intact sensory function in anorexia nervosa. *Am J Clin Nutr* 2012; 95: 272-82.