Visual evaluation of food amount in patients affected by Anorexia Nervosa

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Abstract

Objective: The study compares visual evaluation of an amount of food and an amount of nonedible objects in patients affected by Anorexia Nervosa and control subjects.
Method: 59 anorexic subjects were asked to evaluate an amount of candies and plastic bricks shown to them. Their answers were compared to both the real number of objects and the parallel evaluations given by 56 control subjects.
Results: There were no significant differences in stimuli evaluation between patients affected by AN and control subjects. Both groups reported a significantly lower number of both candies and bricks in comparison to their real number.
Discussion: In an experimental condition not related with food intake there is the same under-evaluation of the amount of presented food and nonedible objects among patients affected by AN and Control Subjects. The clinical finding of overestimation of food intake among patients affected by AN seems not to be due to a perceptive bias.

Keywords: Anorexia Nervosa; Perception; Food amount evaluation; Worry; Drive for control

1. Introduction

In clinical experience patients affected by Anorexia Nervosa frequently claim to feel the uncomfortable impression not to be able to reliably evaluate the amount of served food, engaging the therapists in time consuming Socratic debates about their food intake. We tried to assess if subjects affected by AN are not really able to accurately describe the amount of food to which they are exposed and if there are differences in food dose evaluation among AN patients and control subjects. Moreover we compared the estimation of edible and nonedible stimuli of the same size and shape, to find out if the nature of the stimulus influences the estimation of its amount.

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To our knowledge no research testing food dose evaluation in patients affected by AN has ever been done. There are few studies about their perceptive abilities, however all of them focusing on the patients’ body shape and weight. Epstein et al. (2001), Skrzypek and Wehmeier (2001) report that AN patients haven’t got any perceptive biases: their body size evaluation is based on cognitive factors. These factors probably influence also their food evaluation: Overduin, Jansen, and Louwverse (1995) found Stroop Interference for food related words in anorexic subjects; Urdapilleta, Mirabel-Sarron, Meunier, and Richard (2005) report that among AN patients top-down processes in judging food play a dominating role. When asked to categorize aliments, they cluster them based on consequences of ingestion, (in terms of health, digestion and weight gain) rather than on visual characteristics or palatability, as control subjects would do. In light of these results we carried out the study in an experimental situation without any relation to food intake. This was done to minimize the influence of emotional factors.

2. Subjects and methods

2.1. AN group

60 female subjects affected by bingeing purging AN were recruited at admission in three ED inpatient units in Italy. All participants received detailed information about the procedures and aims of the study, and all gave their written consent. Psychiatrists of the clinical teams of the ED units assessed age, height, weight, comorbidity, and possible past or current psychotherapeutic and/or psychopharmacological treatments. Subjects were informed that all collected data would be strictly confidential. Parental permission was requested for subjects under 18.

Inclusion criteria for the study were: DSM-IV diagnosis of AN ascertained using the SCID interview and a minimum age of 14. Exclusion criteria were: comorbidity of mental retard, cognitive disorders, psychosis, major depression and personality disorder. Thus 59 subjects with a mean BMI of 16.74 (SD 1.75) – ranging from 13.16 to 19.85 – took part in the study. The group included 17 patients with a BMI ranging from 17.60 to 19.85. However they were included anyway as they had met the diagnostic criteria for AN for many years but were currently in remission. This also gave us the opportunity to evaluate the influence of weight regain on the results.

All patients had to have followed a medically controlled diet for at least 10 days prior. This measure was taken to avoid the influence of acute starvation on the results.

The mean age of the group at the time of the interview was 25.23 years (SD 8.64) ranging from 14 to 54 years. The age gap between patients is somewhat big because also patients with a long term illness were included, mainly to find out if the duration of illness influences the results.

2.2. Control group

We recruited 60 female subjects from several secondary and high schools and from an adult school for domiciliary assistants in the town of Cuneo (Italy), during a 3 month period from February to May 2004. The subjects were asked to report previous or current psychiatric disorders and/or treatments and to complete the Eating Disorder Inventory to screen for possible eating disorders.

Four subjects were excluded from the study: 3 subjects were overweight (BMI 31.8, 29.7 and 32.0 respectively) and 1 subject reported bulimic traits. Thus, the control sample was comprised of 56 participants.

The average age of the control group at the time of the interview was 27.91 years (SD 8.41) ranging from 12 to 54 years. There were no significant age differences between the anorexic group and the normal controls (T test: t(113) = -1.68; p>0.05).

The average BMI of the control subjects was 21.40 (SD 2.45) ranging from 17.26 to 24.85.

2.3. Instruments

The subjects were shown two stimuli:

A stimulus: 27 high caloric and tasty yellow candies
B stimulus: 27 plastic yellow LEGO® bricks of the same size and shape as the candies.
Many studies conducted since the seventies have been reporting that estimation of quantity depends on shape, size and disposition of the objects (Ginsburg, 1976; Ginsburg & Deluca, 1979) Therefore it would not be correct to compare stimuli of different size and shape. This is why we used two similar stimuli (one edible and one nonedible). As distance between stimuli influences evaluation of their number, we disposed candies and LEGO® bricks in the same position into two identical white circular plastic plates of 22 cm in diameter.

2.4. Procedure

The study was carried out in a laboratory situation at 10 o’clock in the morning (all subjects had continental breakfast at 8 o’clock) to avoid misperception through hunger on evaluation.

All participants were informed they had to face a test about perceptive ability, patients affected by AN were additionally informed that the results of the test were to have no influence on their diet or therapy.

The subjects were individually asked into a room and exposed to a plate filled with 27 candies (A stimulus) for a short time of 3 s. Then the candies were covered with a drape, and they were asked to evaluate their number.

After about 15 min each subject was individually taken into another room and – again for 3 s – exposed to another plate filled with 27 yellow LEGO® bricks (B stimulus) with the same dimensions and shape as the candies. To avoid order influence the subjects were shown the two stimuli in alternating order.

SPSS 8.0 (SPSS inc., 1999) was used to perform statistical analysis.

3. Results

3.1. AN group

The AN group reported an average of 21.78 candies (DS 6.66). T test analysis revealed that the evaluation is significantly different from the real number (27) of candies ($t(58) = -6.02, p<0.01$).

46 subjects (78%) underestimated the amount of candies, 2 patients (3.4%) guessed their correct number and 11 (18.7%) over-evaluated them. Even considering a range of plus or minus 3 candies as an acceptable margin of error, 38 subjects (64.4%) affected by AN were below the acceptable range, 17 (28.8%) were within and 4 (6.8%) were above.

AN patients estimated 21.22 plastic bricks on average (DS 7.25). Also in this case their evaluation is significantly different from their real number (27) ($t(58) = -6.12, p<0.01$) with 49 subjects (83.1%) underestimating the amount of bricks. This time none of the subjects estimated correctly and 10 (16.9%) over-evaluated their amount.

Even considering a range of plus or minus 3 candies as an acceptable margin of error, 44 subjects (74.6%) were below the acceptable range, 13 (22%) were within and 2 (3.4%) were above. Paired-samples $T$ test didn’t show a significant difference between the evaluations of candies and plastic bricks ($t(58) = -0.78, p>0.05$). Pearson’s correlation analysis found a co-variation between the average of the two evaluations ($r = 0.693, p<0.01$).

Linear Regression was performed to find a possible influence of the subjects’ age and BMI on the results. Neither factor was found to have influenced the subjects’ evaluation. Age plays no role whatsoever in the evaluation of either candies ($R^2 = 0.001, \beta = 0.028, p>0.05$), or plastic bricks ($R^2 = 0.005, \beta = 0.008, p>0.05$), and neither the BMI play a role in the evaluation of candies ($R^2 = 0.000, \beta = 0.006, p>0.05$) and plastic bricks ($R^2 = 0.001, \beta = 0.003, p>0.05$). GLM was performed to find out any illness related factors, such as age of onset, duration of illness or BMI fluctuation over time, could have an impact on the evaluation. No effect on the estimation of either candies ($F(4) = 0.161, p>0.05$) or plastic bricks ($F(4) = 0.29, p>0.05$) was found.

3.2. Control group

The control group reported an average of 23.19 candies (DS 4.56). T test analysis revealed that the evaluation is significantly different from the real number (27) of candies ($t(53) = -6.14, p<0.01$).

44 subjects (78.6%) underestimated the amount of candies, no subjects guessed their correct number and 12 (21.4%) over-evaluated them. Even considering a range of plus or minus 3 candies as an acceptable margin of error, 26 subjects (46.4%) were below the acceptable range, 27 (48.2%) were within and 3 (5.4%) were above.
The control group estimated 21.07 plastic bricks on average (DS 5.35). Also in this case their evaluation is significantly different from the real number (27) ($t(55)=-8.29, p<0.01$) with 49 subjects (87.5%) underestimating the amount of bricks. This time none of the subjects estimated correctly and 7 (12.5%) over-estimated the amount. Even considering a range of plus and minus 3 as an acceptable margin of error, 42 subjects (75%) were below the acceptable range, 11 (19.6%) were within and 3 (5.4%) were above. Paired-samples $T$ test found a significant difference between the evaluations of candies and plastic bricks ($t(53)=-2.35, p<0.05$). Pearson’s correlation analysis didn’t find a co-variance between the average of the two evaluations ($r=0.142, p>0.05$).

Linear Regression was performed to find a possible influence of the subjects’ age and BMI on the results. Age plays no role whatsoever in the evaluation of either candies ($R^2=0.048, \beta=0.121, p>0.05$), or plastic bricks ($R^2=0.027, \beta=0.102, p>0.05$), and neither the BMI plays a role in the estimation of candies ($R^2=0.01, \beta=0.187, p>0.05$) and plastic bricks ($R^2=0.023, \beta=0.331, p>0.05$).

3.3. Comparison between AN and control group

Using ANOVA we found that there are no significant differences in the estimation of candies ($F(1)=1.684, p>0.05$) or plastic bricks ($F(1)=0.016, p>0.05$) among either group. The data was further confirmed using Chi square analysis with an estimation range of 27 plus or minus 3 for candies (Chi square (2)=4.590, $p>0.05$) and for plastic bricks (Chi square (2)=0.535, $p>0.05$).

4. Discussion

The study found that patients affected by AN and control subjects estimate the amount of food or nonedible objects shown to them in the same way. Both lack the ability to estimate the number of stimuli correctly underestimating them compared to their real number.\(^1\) The nature of the stimulus (edible or not) doesn’t influence the evaluation of its amount. Among AN patients there is no correlation between evaluation of either stimulus and age of onset of AN, years of illness, current BMI or fluctuation of BMI over time.

The general underestimation found in both groups could be due to a perceptive effect described by Ginsburg (1976, 1978, 1980, 1991) among adults and by Ginsburg and Deluca (1979) among children: the arrangement of the stimuli influences the evaluation of their amount. Randomly disposed sets are underestimated compared to their real number, whereas ordered stimuli are generally overestimated. In our experiment as in real life food was randomly arranged on the dish so our results are in accordance with these findings.

The results of the study apparently contrast the common clinical finding of overestimation of food intake among AN patients, but the discrepancy can be explained with the differences between clinical and experimental settings. In real life perception not only results from a flow of sensory information from periphery to brain ("bottom-up" processing), but also involves the selection of inputs that are most relevant for the subjects’ experiences and expectations, ("top-down" processing) (Urdapilleta et al., 2005). To our knowledge, no brain imaging studies about food evaluation among AN patients have been done yet. However, Seeger, Braus, Ruf, Goldberge, and Schmidt (2002), having used brain imaging technologies, found that in AN patients the vision of their own body digitally oversized was associated with the activation of the brain’s fear network: amygdala, right gyrus fusiformis and brainstem region. One could therefore hypothesize that clinical experience of over-evaluation among those patients might be due to activation of similar "top-down" processing rather than "bottom-up" perceptual disturbances. They might recognize their food as “not much” but evaluate it as “too much” for them.

In order to limit the effects of top-down processing, in our study subjects were informed that the results of the test would have no effect on their diet and that they wouldn’t have to eat the presented food. This way the emotional brain networks related to food intake and weight increase were probably not highly active but “bottom-up” perceptive processes were primarily involved. These perceptive processes appear, in our study, similar among AN patients and control subjects.

Further studies might need to be conducted to find out if food amount evaluation changes when “top-down” emotional processes are activated, as they are when the subjects have to eat the food shown to them.

\(^{1}\) In light of these results it seems useless to spend much time during therapy with Socratic debate about patients’ real food intake as they appear equally incapable of evaluating an amount of food as normal subjects.
From our results another question arises: "Is general underestimation of the amount of food an unrelated condition or does it play a role in onset and maintenance of eating disorders?" We don’t have enough experimental evidences to answer this question yet, but we hypothesize that even if tendency to underestimation has no direct effect on the onset of AN, it could promote a noneasily resolvable worry about food intake; a risk factor for AN (Sassaroli & Ruggiero, 2005; Strober, 1995).

Among people not affected by eating disorders underestimation of the amount of food probably has no effect, because their regulate food intake based on their hunger or satiety and not on the evaluation of its amount. On the contrary AN patients being unable to regulate their food intake on inner sensation of hunger and satiety (Garner, Olmsted, Polivy, & Garfinkel, 1984; Miller, Redlich, & Stein, 2003), are blind and deaf towards food. This incapability could induce them to control the amount of food to regulate its intake. Not being able to correctly evaluate it, moreover underestimating it, could enhance the sense of insecurity and missing control about food, pervasively felt by anorexic subjects.

In conclusion we hypothesize that food dose under-evaluation is not an innocent bystander, but in subjects with tendency to control, it could play a role in the multidimensional mechanisms of onset and maintenance of Anorexia Nervosa.

References


