

# **Anorexic Subjects Underestimate the Amount of Food**

**Vinai Piergiuseppe (piervinai@tin.it)**

“Studi Cognitivi”, Post-graduate Cognitive Psychotherapy School, 27 Montebello street, Milano, 20121 Italy.

**Ferrato Noemi**

“Studi Cognitivi”, Post-graduate Cognitive Psychotherapy School, 27 Montebello street, Milano, 20121 Italy

**Cardetti Silvia**

“Studi Cognitivi”, Post-graduate Cognitive Psychotherapy School, 27 Montebello street, Milano, 20121Italy.

**Vallauri Paola**

“Studi Cognitivi”, Post-graduate Cognitive Psychotherapy School, 27 Montebello street, Milano, 20121 Italy.

**Carpegna Gabriella**

Studi Cognitivi”, Post-graduate Cognitive Psychotherapy School, 27 Montebello street, Milano, 20121 Italy.

**Masante Donatella**

“Studi Cognitivi”, Post-graduate Cognitive Psychotherapy School, 27 Montebello street, Milano, 20121 Italy.

**Luxardi Gianluigi**

Eating Disorders Unit ASL N° 6 " Western Friuli "  
S. Vito al Tagliamento Pordenone, Italy

**Ostuzzi Roberto**

Eating Disorders Unit Villa Margherita  
Vicenza, Italy,

**Pozzato Marita**

Eating Disorders Unit Villa Margherita  
Vicenza, Italy,

**Todisco Patrizia**

Eating Disorders Unit of Spedali Riuniti  
Brescia Italy

**Ruggiero Giovanni**

“Studi Cognitivi”, Post-graduate Cognitive Psychotherapy School, 27 Montebello street, Milano, 20121 Italy

**Sassaroli Sandra**

“Studi Cognitivi”, Post-graduate Cognitive Psychotherapy School, 27 Montebello street, Milano, 20121 Italy.

## **Abstract**

People affected by eating disorders often misjudge their food intake. This misjudgement might be due to fear of eating and of the amount of food eaten. This study contrasted normal

peoples and anorexic patients capability to evaluate amounts of food. We also investigated the influence of unnatural color and odor of food on the perception of the amount. A group of anorexic subjects was asked to evaluate how many biscuits were used to prepare of a certain amount of broken biscuits.

The anorexic subjects were also asked to evaluate the number of a certain amount of broken biscuits that had been dyed blue. The blue color altered both the aspect and the odor of the biscuits. The evaluations given by the anorexic subjects were compared to both the real number of biscuits and to the parallel evaluations given by a control group of non eating disordered people. Anorexic subjects reported a significantly lower number of both altered and non-altered biscuits in comparison to both the real number of biscuits and the evaluations reported by the control group. There were no significant differences between the evaluations of altered and non altered biscuits of both anorexic subjects and control subjects. The study suggests that anorexic subjects show an altered perception of the amount of food. Altered perception may play a role in the onset and maintenance of anorexia nervosa.

### Objective

Energy intake and food consumption is influenced by many factors. Among them, there are visual factors as the evaluation of the amount and of the aspect of food (Albright & Sterns, 1995). Both the classical models by Blundell & Hill (1987) and by Both (1981) have proposed that the perception of hunger and satiety integrates the cognitive set of individual's attitudes toward food with the internal physiology of neurotransmitters, hormones, and metabolism. Research suggests that the hunger-satiety system is altered in eating disordered subjects (Owen, Halmi, Gibbs, & Smith, 1985). According to Garfinkel, Moldofsky, & Garner (1979), anorexic subjects have an absence of aversion to repeated highly sweet tastes (i.e., sucroses). Moreover, such a disturbance was stable over the year and was not affected by weight change.

Other studies have examined the influence of visual perception on hunger and satiety. Gosnell, Mitchell, Lancaster, Burgard, Wonderlich, & Crosby (2001) found that the amount of food presented to obese subjects stimulates overeating or binge eating. Staiger, Dawe, & McCarthy (2000) and Neudeck, Florin, & Tuschen-Caffier (2001) found that the visual presentation of high-caloric food elicited binge eating in bulimic subjects. Such an association is also a common sense observation: a proverb of the Italian popular wisdom says: "eyes are bigger than mouths", that means that the more the food is exposed to glance the more the urge to eating and binge eating is elicited. High-caloric food stimulates appetite also via their tempting aspect and scent.

In our clinical experience anorexic subjects frequently reported that during the mealtime they feel the uncomfortable impression not to be able to reliably evaluate the amount of served food. To our knowledge, there are no study which examined the visual ability to evaluate exposed food in anorexic subjects. The study compared visual evaluation of food in anorexic subjects and normal controls. Afterward, the study was repeated using artificially colored food to evaluate the possible influence of color and odor.

## Materials and Method

### Sample

Thirty-six anorexic subjects were recruited in the eating disorders unit of the Clinica Villa Margherita (Vicenza, Italy), directed by dr. R. Ostuzzi, and in the eating disorders unit of the ASL (Azienda Sanitaria Locale) n° 6 "Friuli Occidentale" of S. Vito al Tagliamento (Pordenone, Italy) directed by dr. G. Luxardi. The criteria for inclusion in the study were: DSM-IV diagnosis of Anorexia Nervosa ascertained using the SCID interview; minimum age of 14 years; ability to speak Italian with adequate fluency, absence of cognitive disorders. All participants received detailed information about the procedures and aims of the study, and gave written informed consent. During the interview age, height, weight, and possible past or current psychological and/or psychopharmacological treatments were assessed. Subjects were informed that all collected data would be strictly confidential. All of them agreed to participate and signed an informed consent form. Parental permission was requested for subjects who were younger than 18 years old. Two subjects were excluded because actually in remission and presenting a normal BMI (20.66 and 20.86 respectively). Thus, 34 subjects took part in the study. Twenty-seven patients presented the bingeing/purging subtype of anorexia nervosa and 7 participants presented the restricting subtype of anorexia nervosa.

The mean age of anorexic group at time of interview was 25.21 years (St. Dev. 6,23) ranging from 14 to 44 years. The mean BMI of the patients was 15.52 (St. Dev. 1.02) ranging from 14.03 to 17.28. The average age of the onset of the eating disorder (as reported by participants) was 18.24 years (St. Dev. 4.38) ranging from 9 to 27 years.

Forty normal control female subjects were recruited in a high school and in a training school for domiciliary assistants in the town of Cuneo (Italy), during a period of 2 month from May to June 2002. The subjects were asked to report previous or current psychiatric disorders and treatments and to complete the Eating Disorder Inventory for a screening for eating disorders. Six subjects were excluded from the study: 1 subject reported a diagnosis of major depression, 3 subjects reported slight bulimic traits, and 2 subjects were overweight (BMI 27,8 and 32,8 respectively). Thus, the control sample investigated in this study comprised 34 participants.

The mean age of the control group at time of interview was 22.47 years (St. Dev. 6,92) ranging from 15 to 40 years. There were no significant difference of mean age between the anorexic group and the normal controls.

### Instruments and Procedure

The study was carried out in a laboratory situation in which all the subjects were introduced in a room and exposed to a plate fulfilled with 9 high caloric and tasty biscuits of a famous Italian brand, each of them divided in 4 equal parts by a crossing cut (36 parts in total). The subjects were

exposed to the food for the short time of 3 seconds. After 3 seconds, the biscuits were covered with a drape, and the subjects were asked to evaluate the number of presented broken biscuits. After a while all the subjects were introduced in another room and exposed to another plate fulfilled with 9 other biscuits of the same kind and brand and divided in the same way, but with color and odor altered using blue ink and ammonia. The 2 plates were exposed in different rooms to prevent visual confrontation.

The t-test for equality of means was used to compare the evaluations of anorexic subjects and normal controls, whilst the one-sample t-test (test value=9) was used to compare the evaluations of anorexic subjects and the real number of biscuits. SPSS 10.0 (SPSS inc., 1999) was used to perform statistical analysis.

## Results

Anorexic patients evaluated a mean of 6.44 non altered biscuits (st. dev. 2.26), whilst the normal subjects evaluated a mean of 9.38 non altered biscuits (st. dev. 4.38). The difference between the two groups was significant, i.e.  $t=-3.478$ ; Sig. (2-tailed)=.001. The difference between the evaluations of non altered biscuits by the anorexic subjects and the number of real biscuits was significant, i.e.  $t=-6.605$ ; Sig. (2-tailed)=.000.

Anorexic patients evaluated a mean of 6.14 altered biscuits (st. dev. 1.88), whilst the normal subjects evaluated a mean of 10.12 altered biscuits (st. dev. 5.93). The difference between the two groups was significant, i.e.  $t=-3.724$ ; Sig. (2-tailed)=.001. The difference between the evaluations of altered biscuits by the anorexic subjects and the number of real altered biscuits was significant, i.e.  $t=-8.863$ ; Sig. (2-tailed)=.000.

There were no significant differences between the evaluations of non altered and altered biscuits in both anorexic subjects, i.e.  $t=.584$ ; Sig. (2-tailed)=.561, and normal controls, i.e.  $t=.582$ ; Sig. (2-tailed)=.563.

Considering the two subtypes of anorexic subjects separately, binge/purging anorexics evaluated a mean of 6.30 non altered biscuits (St. Dev. 2.40) and a mean of 5.85 altered biscuits (st. dev. 1.77). These results were both significantly different from the evaluations of control subjects, i.e.  $t=-3.498$ ; Sig. (2-tailed)=.001 and  $t=-3.979$ ; Sig. (2-tailed)=.000, respectively. These results were also both significantly different from the real number of biscuits, i.e.  $t=-5.856$ ; Sig. (2-tailed)=.000 and  $t=-9.245$ ; Sig. (2-tailed)=.000, respectively.

Restricting anorexics evaluated a mean of 7.00 non altered biscuits (st. dev. 1.63) and a mean of 7.29 altered biscuits (st. dev. 1.98). These results were both significantly different from the evaluations of control subjects, i.e.  $t=-2.449$ ; Sig. (2-tailed)=.021; and  $t=-2.245$ ; Sig. (2-tailed)=.032 respectively. The number of non altered biscuits was significantly lower from the real number of biscuits, i.e.  $t=-3.240$ ; Sig. (2-tailed)=.018, whilst the number of altered biscuits was not significantly different

from the real number of biscuits, i.e.  $t=-2.295$ ; Sig. (2-tailed)=.061.

There were no significant differences between the evaluations of non altered and altered biscuits in both binge/purging subtype anorexic subjects, i.e.  $t=.775$ ; Sig. (2-tailed)=.442, and restricting subtype anorexic subjects, i.e.  $t=.295$ ; Sig. (2-tailed)=.773.

## Discussion

The study has shown that anorexic subjects tend to underestimate in significant extent the amount of exposed food in comparison to both the evaluations of non eating disordered subjects and to the real amount of exposed food. This underestimation is not influenced by artificial alterations of color and odor. Considering the two diagnostic subtypes of anorexia separately, the significant underestimation is confirmed but in the case of the estimation of altered biscuits in restricting anorexia, that is not significantly lower than the real amount of biscuits. However, the value of this finding is questioned, in consequence of the small size of the sample of restricted anorexics, only 7 subjects

The visual evaluation of the amount of food is the opening phase of the hunger-satiety and eating process. Thus, this study confirms previous works that have shown that this process is altered in eating disordered subjects. However, previous research examined mainly the following phases of the process, specifically the effect of ingested food on satiety. Research has shown that anorexic subjects lack the satiety aversion to exceeding and repeated sweet taste (Garfinkel, Moldofsky, & Garner, 1979). The subsequent picture is that anorexic subjects would be incapable to both estimate both the amount of food exposed and the amount of eaten food. Thus both the phases preceding (visual estimation of food) and following (lack of satiety aversion) the mealtime are compromised. A further clue of alteration of hunger and satiety in anorexia are the findings that about 20-30% of anorexic people had a weight increase before the onset of the disorder and that anorexic girls often gain weight until obesity after the relapse (Haiman & Devlin, 1999; Spurrell, Wilfley, Tanofsky, & Brownell, 1997).

The disorder of the whole hunger-satiety process in anorexic subjects is plausibly a maintaining factor for the eating disorder itself (Hetherington & Rolls, 2001). Altered interoceptive awareness, comprising also the confusion regarding hunger and satiety, is a well known aspect of eating disorder (Garner, Olmsted, Polivy, & Garfinkel, 1984; Miller, Redlich, & Steiner, 2003). The visual underestimation of the amount of food could be a further aspect of this lack of ability of anorexic subjects. In turn, such perceptive confusion could underlie higher level feelings of fear regarding food, eating, weight, and fat, that could definitely pave the way and trigger the final cognitive level, i.e. beliefs regarding the compelling necessity to control eating and food to remove the painful turmoil of such troubled and uncomfortable feelings. The assumption

or the feeling of needing self-control may trigger dietary behaviors and restrictions that would enhance the subjective sense of self-esteem and self-control, both of which are pervasively negative, if not lacking without remedy, in the anorexic subjects (Slade, 1982; Vitousek & Hollon, 1990; Fairburn, Shafran, & Cooper, 1999).

An unbalanced hunger-satiety process may both precede the eating disorder and be increased by the wrong eating habits induced by the eating disorder itself. It is known that wrong eating habits and disordered attitudes and beliefs regarding weight and eating are frequent in the families of eating disordered subjects (Woodside, Bulik, Halmi, Fichter, Kaplan, Berrettini, Strober, Treasure, Lilenfeld, Klump, & Kaye, 2002) and that parental obesity is a risk factor for the development of eating disorders (Vandereycken, 2003). One could even hypothesize a genetic tendency to the hunger-satiety confusion. In addition, there are also cultural and social factors underlying such confusion. In fact, the tendency to underestimate both the amount of food and the signs of satiety may be the extreme form of a general issue of people living in contemporary affluent societies. The tendency to underestimate food intake and satiety is a protective factor against food's shortage and stimulates the accumulating fat to survive to eventual food's scarcity. However, in an affluent era of food abundance and sedentary work activities, as nowadays, the protective factor may become a risk factor for overweight and obesity, for it plausibly stimulates overeating. In addition, it is possible that a genetic or learned incapability to correctly estimate the food intake could be a risk factor even for anorexia nervosa. In fact, such an incapability could enhance that above-mentioned sense of insecurity and missing control pervasively felt by anorexic subjects. Hence, it could be stated that behind some anorexic subjects is masked an obese girl or woman. A confirmation comes from another study of this research team, that used the same experimental procedure and found that also obese subjects usually underestimate the amount of presented biscuits (Vinai, Masante, Ruggiero, & Sassaroli, 2002).

Further studies using whole objects are necessary to evaluate if this altered perception is an effect of a perceptive bias or an inability to calculate how many whole biscuits could produce that amount of broken biscuits.

Furthermore other studies are requested using not eatable objects to evaluate if this perceptive bias is induced or not by the view of the food.

At the light of this study, if confirmed, we can think that sometimes, an obese, a bulimic or an anorexic person can be only different end points of the same perceptive disorder.

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