



## Neuropsychological investigation of decision-making in anorexia nervosa

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### Abstract

Anorexia nervosa (AN) could be considered a form of obsessive–compulsive disorder in which an impairment of the cognitive domain related to decision-making was found. We explored this function in AN patients, as well as possible differences between restricting type and binge/purge type, with the aim of examining the hypothesis that AN is part of the obsessive–compulsive spectrum. Decision-making was assessed in 59 inpatients with AN and 82 control subjects using the Gambling task, which simulates real-life decision-making by assessing the ability to balance immediate rewards against long-term negative consequences. We confirmed the supposed deficit of decision-making in AN. However, restricting and binge eating/purge subtypes showed different patterns of decision-making impairment. Poor performance on the Gambling task is not a mere consequence of starvation and does not appear to be related to illness severity. The decision-making deficiency that some AN patients show is linked to those individual features that contribute to the phenomenological expression of the disorder.

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### 1. Introduction

Several authors have suggested that anorexia nervosa (AN) could be considered a form of obsessive–compulsive disorder (OCD) (Halmi et al., 2003). At present, there is evidence from familial and genetic studies that eating disorders (ED) should be considered as one of the obsessive–compulsive

spectrum disorders (Matsunaga et al., 1999). In fact, in families of patients with AN and bulimia nervosa, there is a significantly increased familial risk for OCD and chronic tics, without any relationship with the OCD/tic co-diagnosis in the proband (Bellodi et al., 2001). Furthermore, a segregation study on Italian ED families showed that ED and OCD are transmitted in ED families following an additive Mendelian model of transmission (Cavallini et al., 2000).

Neuropsychological studies, often associated in patients affected by ED have revealed an impairment in several cognitive domains (Fassino et al.,

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2002; Murphy et al., 2002; Tchanturia et al., 2002). As for OCD, the relevant literature indicates that these patients exhibit an impairment of executive functions, consistent with the OCD pathogenetic model involving dysfunctions of the fronto-striatal circuits (Cavedini et al., 1998, 2001, 2002a). However, neuropsychological studies in AN have not yet produced a replicable neurofunctional model of this disorder, although various forms of cognitive impairment in visual memory and visuospatial abilities, attention and working memory have been found (Kingston et al., 1996; Mathias and Kent, 1998).

The poor neuropsychological performance found in AN patients could be considered as a mere consequence of starvation and brain atrophy, suggesting that the cognitive deficits of patients with AN are mainly related to weight loss and nutritional status (Lauer et al., 1999). In fact, cognitive dysfunctions assessed in an active phase of AN show a significant improvement with clinical remission (Szmukler et al., 1992; Takano et al., 2001; Moser et al., 2003). Considering these limitations, recent data suggest that a dysfunction in neuronal circuitry may be related to AN (Naruo et al., 2000), and a possible involvement of the orbitofrontal cortex in the pathophysiology of this disorder is also supported by the literature (Fassino et al., 2002), as also seen in OCD. Therefore, the use of a specific neuropsychological task, sensitive to frontal lobe dysfunctions, may be potentially very useful to investigate the involvement of this brain area in AN.

Recently, a neuropsychological procedure sensitive to ventromedial prefrontal cortex functioning, the Gambling task (GT; Bechara et al., 1994), has been used to discriminate neuropsychological decision-making performance in OCD compared with healthy controls and patients with panic disorder (Cavedini et al., 2002a; Cavallaro et al., 2003). Furthermore, the task identifies neuropsychological malfunctioning similarities in pathological gamblers (Cavedini et al., 2002b) that are supposed to belong to the compulsive–impulsive dimension of the OCD spectrum (Blaszczynski, 1999). The identification of similar cognitive deficits in AN could help to identify common neurofunctional correlates among these disorders.

The aim of this study is to explore the decision-making functioning of AN patients, whose neurofunc-

tional impairment might support the hypothesis that AN is part of the OCD spectrum. We want to evaluate possible differences in decision-making between AN restricting type and binge eating/purge type that are related to dissimilar clinical characteristics of illness. Moreover, the hypothesis of decision-making impairment in these patients could suggest possible orbitofrontal involvement in the pathogenesis of this disorder.

## 2. Methods

### 2.1. Subjects and clinical assessment

The sample studied consisted of 141 subjects: 82 healthy control subjects (HC) and 59 patients with anorexia nervosa (AN). Patients with AN were recruited consecutively from the inpatients unit for the treatment of eating disorders at the Department of Neuropsychiatric Sciences, San Raffaele Hospital, Milan. The diagnosis was made by a resident psychiatrist according to DSM-IV criteria (American Psychiatric Association, 1994): 26 patients satisfied criteria for AN restricting subtype (AN-R) and 33 patients for binge eating/purge subtype (AN-BE). Healthy controls were recruited through local advertisement among college students, administrative staff and other workers at the Hospital. Subjects with multiple diagnoses in the AN group and with any lifetime diagnosis in the HC group were excluded from this study. Subjects were not included if a history of mental retardation, neurological illness, brain injury or trauma, or drug or alcohol abuse was reported. After complete description of the study to the subjects, written informed consent was obtained.

Before neuropsychological evaluation, severity of illness in the AN patients was assessed using the Yale-Brown Cornell Scale (Y-Cornell; Mazure et al., 1994), and the body mass index (BMI), expressed as  $\text{kg/m}^2$ , was measured for each patient.

### 2.2. Neuropsychological testing procedure

The neuropsychological battery consists of the following measures: (a) the Gambling task, for the investigation of decision-making; (b) Weigl's Sorting Test; (c) the Object Alternation Test; and (d)

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