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Research report

# Odor perception in patients with mood disorders

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**Abstract**

*Backgrounds:* Olfaction has obvious correlates with emotional processes but little is known about the several aspects of olfaction in psychiatric disorders characterized by mood disturbance. This research aims at pointing out the specificities of olfactory perception in patients in order to identify the specific cerebral impairments involved in these disorders.
*Methods:* Olfactory sensitivity, detection, identification, self-evaluation of intensity and pleasantness have been recorded in a control group of healthy subjects ($N=58$) and in three sample populations admitted to a Psychiatry Department: depressive patients ($N=49$), anorectic patients ($N=17$), and patients suffering from addiction to alcohol or drugs ($N=21$).
*Results:* Depressive patients have a poor sensitivity, poor detection abilities but over-evaluate the pleasantness of odors. Anorectic patients have a high sensitivity, over-evaluate the intensities of the odors but under-evaluate their pleasantness. Alcoholic/drug addicted patients showed impairments in identification.
*Limitation:* This study does not identify inter-individual differences in olfactory perception.
*Conclusion:* The psychiatric diseases, here at hand although every one of them may be characterized by depressive components, show diverging impairments in olfactory perception. When variations in sensitivity are usually attributed to peripheral cues, impairments in emotional and cognitive aspects of olfaction are typically related to specific brain structures and processes which could be particularly involved in these diseases.


*Keywords:* Odor; Depression; Anorexia; Alcoholism; Drug addiction

## 1. Introduction

The sense of smell can be considered as being unique for its high capacity to interfere with emotions and mood (Ludvigson and Rottman, 1989; Millot and Brand, 2001; Miltner et al., 1994; Van Toller, 1988; Schiffman et al., 1995). The connections of olfactory pathways with direct projections to the limbic system are usually put forward to explain these correlates (Brand et al., 2001; Rolls et al., 2003; Royet et al., 2001; Savic, 2001).

Considering this background, one may wonder which characteristics of olfactory perception in subjects affected by emotional disturbances may be observed, as it is the case in psychiatric disorders. Apart from schizophrenia (Moberg et al., 1999; Minor et al., 2004; Turetsky et al., 2003) little is known about other diseases with emotional dysfunctions. Mood disorders are salient in Major Depression, and frequently reported in alcoholism, drug addiction and eating disorders (Corcos et al., 2000). Testing the identification

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ability of depressed patients, Amsterdam et al. (1987) did not find any significant differences with control subjects. These results were confirmed by Warner et al. (1990) and by Settle and Amsterdam (1991). But Serby et al. (1990, 1992), Steiner et al. (1993) noted lowered scores in identification. A recent study (Pause et al., 2001) concluded to a reduced sensitivity in these patients.

Concerning other diseases with mood disorders, Rupp et al. (2003) noted lowered scores in sensitivity, discrimination and identification in patients with alcohol dependence compared to control subjects. Reduced odor identification abilities had previously been shown in these patients (DiTraglia et al., 1991; Shear et al., 1992). Fedoroff et al. (1995) mentioned olfactory impairment in very low-weight anorectics for sensitivity and identification. In contrast, Kopala et al. (1995) did not find any differences in identification between patients with anorexia nervosa and control subjects. Roessner et al. (2005) did not confirm deficits in identification, but mentioned deficits in sensitivity and discrimination in anorexia nervosa.

None of these studies explored simultaneously the different aspects (sensitivity, detection, intensity, pleasantness, identification. . .) which are usually assigned to olfactory perception. Furthermore, most studies used a few of different odors. In that way, considering the numerous inter-individual differences in olfactory perception, the differences of methods and odors tested could explain some discrepant conclusions between the studies as it is frequent in this area of research (Brand and Millot, 2001).

The aim of this present study is to characterize and compare the usual psychophysical dimensions of olfaction in groups of patients affected by these psychiatric disorders. The further challenge is to explain the specific differences observed when checking the data about the brain substrates of olfactory perception and those of these psychiatric diseases, when they are identified.

## 2. Methods and materials

### 2.1. Subjects

We have considered a control population and three sample populations according to the medical diagnosis (DSM IV). All the patients were admitted to the Psychiatry Department of the Hopital de Besançon (East of France) when the data were collected.

- A sample population of depressive patients included 49 subjects (age: mean=43.4 years and SD=17.54: 35 females). The criteria of inclusion was the one and only diagnosis of severe depression, without other psychiatric diseases. The mean of Beck's Depression Inventory (BDI) scores was 23.75 (SD=5.74).
- A sample population of patients suffering from anorexia nervosa, restricting subtype, included 17 females (mean age=22.7; SD=6.86). The mean Body Mass Index (BMI) was 14.59 (SD=2.58) and the mean BDI was 17.33 (SD=5.34).
- A sample population of patients suffering from alcohol or drug addiction ($N$=21: 9 females; mean age=38.47; SD=13.06; 12 of them were alcoholic and 9 were addicted to drugs). The mean BDI was 14.9 (SD=10.7). They were not suffering from other psychiatric diseases or cognitive impairments.
- Healthy subjects ($N$=58) were recruited to constitute a control group approximately matched with the hospitalised group for sex, age and smoking habits (36 females; age: mean 38.4; SD=13.96). These subjects described themselves without history of psychiatric or neurological disorders.

All participants gave written consent, and the study was approved by the local ethical committee for clinical studies.

### 2.2. Procedures of olfactory testing

The study of the olfactory perception was performed by means of the "Test Olfactif," conceived by EZUS (University Lyon II, Fr.) for measures of olfactory perception with a French population (Thomas-Danguin et al., 2003).

This test evaluates firstly the olfactory sensitivity with 2 odors: L-carvone (a menthol like odor) and tetrahydrothiophene (an additive odor for gas), with a forced choice procedure for 5 successive concentrations. Taking into account the results for both odors, a score is attributed between 2 (high sensitivity) to 10 (low sensitivity).

Secondly, the test evaluates the detection and identification abilities with a panel of 16 odors (vanilla, lavender, eucalyptus, fuel, fish, violet, garlic, grass, orange, apple, cinnamon, lemon, anise, mulberry, chewing-gum, mint). For each of them, the subjects designed the bottle with an odor among four bottles (detection test) and then chose its correct label among a list of four names (identification test).

Furthermore, we added to this routine test self-ratings of intensity and hedonic valence on linear scales