



## Emotional hyperreactivity as a core dimension of manic and mixed states

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### ABSTRACT

Despite its obvious importance in mood disorders, characterization of emotional reactivity has been neglected in bipolar disorders. Concerning manic states and the current classification, the main criterion is the presence of an elevated or expansive mood. In contrast to this characteristic and often prolonged mood state, emotional reactivity refers to a brief evoked response to salient emotional stimuli. The goal of this study was to assess the intensity of emotional responses triggered by viewing slides in bipolar patients with manic or mixed states. Our hypothesis was that all emotional responses are exacerbated, whatever the valence of the stimuli. We compared 33 patients with manic or mixed states with 33 matched euthymic patients and 33 healthy control subjects. Arousal and attribution of valence were assessed while subjects viewed slides taken from the International Affective Picture System (positive, neutral and negative slides). Patients with manic or mixed states reported a higher arousal when viewing all types of slides in comparison with the other groups. Concerning attribution of valence, patients with manic or mixed states assessed neutral slides as more pleasant. When bipolar patients with manic and mixed states are placed in front of positive, neutral and negative slides, the slides trigger a higher intensity of emotions, whatever the valence of the emotional stimuli. These results strengthen the importance of emotional hyperreactivity as a core dimension in manic and mixed states in bipolar disorder.

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### 1. Introduction

Despite its obvious importance in mood disorders, the characterization of emotional reactivity has been neglected in the spectrum of bipolar disorders. The main criterion for bipolar disorder is the occurrence of a durable mood disturbance: sadness during depressive episodes and elevated or expansive mood in manic states. In contrast to this lengthy duration of a mood state, emotional reactivity refers to a brief evoked response to salient emotional stimuli (Henry et al., in press). Generally, moods and emotions have been seen as interconnected, with the idea that moods may potentiate correspondingly valenced emotions. Thus, sad mood is thought to exacerbate emotional reactivity when subjects are exposed to negative stimuli, and euphoria is thought to trigger more intensive responses when subjects are confronted with positive stimuli. However, the data do not support this hypothesis (Rottenberg et al., 2005). Moreover, most manic states not only exhibit euphoric

mood but also a characteristically high lability of affect states. Beyond the euphoric response, an unresolved issue is the ability of patients to respond to external stimuli. This issue is critical because the level of adaptation of an individual depends on his or her ability to respond to environmental stimuli.

Mood in manic episodes is characterized by high lability in most patients. Goodwin and Jamison (Goodwin and Jamison, 2007) found that the most frequent emotions during the manic state were irritability (71%), followed by euphoria (63%), expansiveness (60%), mood lability (49%) and depression (46%). Factor analyses assessing the dimensions involved in manic states revealed the presence of a depressed component in most manic episodes, regardless of whether they were pure or mixed states (Cassidy et al., 1998; Dilsaver et al., 1999; Azorin et al., 2000; Swann et al., 2001; Rossi et al., 2001; Gonzalez-Pinto et al., 2003; Suppes et al., 2005; Sato et al., 2002). Given this high variability in the tonality of mood, it is important to understand what happens in terms of emotional reactivity. In a previous study, we showed that patients with a manic or mixed state reported experiencing emotions more intensely than usual (Henry et al., 2003).

The aim of this experiment was to study emotional response (arousal and attribution of valence) triggered by positive, negative

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or neutral slides in manic and mixed states in bipolar patients and to compare responses to those in euthymic bipolar patients and control subjects. Our hypothesis was that all emotional responses would be exaggerated in manic and mixed states, whatever the valence of the stimuli.

## 2. Method

### 2.1. Participants and clinical assessment

The sample included 99 subjects who were subdivided as follows: 33 were bipolar patients during a phase of remission (euthymic group), 33 had a manic ( $n = 16$ ), hypomanic ( $n = 10$ ) or mixed ( $n = 7$ ) episode as defined by DSM-IV (for convenience, all these patients are referred to as the manic group, see Section 4 for more details), and 33 were control subjects.

All subjects were assessed by a trained psychologist using the Diagnostic Interview for Genetic Studies (DIGS) to provide DSM-IV diagnoses (Nurnberger et al., 1994), and the severity of depressive and manic symptoms was quantified using the Montgomery and Åsberg Depression Rating Scale (MADRS) (Montgomery and Åsberg, 1979) as well as the Bech-Rafaelsen Mania Rating Scale (MAS) (Bech et al., 1978).

The euthymic bipolar group included patients who did not meet DSM-IV criteria for a full episode at the time of evaluation and who had a MADRS score below 12 and a MAS score below 4. The control group, which was recruited by advertising, included participants without any psychiatric axis I disorder.

The investigation was approved by the ethics committee of the University Hospital Center (Toulouse, France) for clinical research. All subjects provided written informed consent to participate.

### 2.2. Experimental design

Emotional response was evaluated by inducing emotions through emotional visual stimuli. Participants were placed in a room with filtered light in front of a computer screen (1 m) on which a series of 18 slides (6 positive, 6 neutral and 6 negative) from the International Affective Picture System (IAPS) (Lang et al., 1995) was presented randomly. The set consisted of a succession of six trios, each trio consisting of a positive slide, a neutral slide, and a negative slide. The order of the slides within the set was counterbalanced, so there were six different orders of presentation. Each slide was presented for 10 s, followed by a dark gray screen, which was also presented for 10 s.

The subjects were asked to evaluate valence and arousal for each slide using the Self-Assessment of Manikin (SAM) (Lang et al., 1995), a 9-point visual analog scale. Arousal describes the intensity of emotion triggered by slides, and valence the pleasantness or hedonic value (Stickel et al., 2009). Regarding valence, low scores were indicative of unpleasant slides, and high scores were indicative of pleasant slides. For arousal, low scores were indicative of low intensity of emotion, and high scores were indicative of strong emotion.

### 2.3. Statistical analysis

Analyses were carried out with the Statistical Package for the Social Sciences (SPSS, version 14 for Windows). The  $\chi^2$  test was used to compare categorical qualitative data. Analysis of variance (ANOVA) was used to compare averages of quantitative continuous variables. Post hoc Tukey HSD (honestly significant difference) tests for pairwise comparisons were used to determine whether there was any significant difference among groups in terms of valence and arousal evaluation. Although there is empirical evidence that ANOVA is quite robust regarding violation of the assumption of normality (Schmider et al., 2010) and departures from the assumption of homogeneity of variance (Grissom, 2000), we systematically checked the results of the ANOVA using appropriate nonparametric tests (Kruskal–Wallis  $H$  and Mann–Whitney  $U$  tests) in case of significant deviations from normal distribution and heterogeneity of variance. The normality of distribution of each variable was assessed using a normal probability plot and the Shapiro–Wilk test. The homogeneity of variance was assessed using Levene's test. For all tests, significance was set at  $p < 0.05$ , two-tailed.

## 3. Results

### 3.1. Analysis of sample characteristics

We conducted analyses concerning sociodemographic variables and mood states on the three groups. There was no significant difference between the groups regarding age,  $F(2, 96) = 0.06$ , and all groups were similar regarding the proportion of men and women ( $\chi^2 = 0.3$ , d.f. = 1,  $p = 0.6$ ) and marital status ( $\chi^2 = 0.9$ , d.f. = 2,  $p = 0.6$ ). Manic patients were more symptomatic than euthymic bipolar patients and controls. The group effect was statistically significant both for the MADRS,  $F(2, 96) = 72.08$ ,  $p < 0.001$ ,  $\eta^2 = 0.60$ , and the MAS,  $F(2, 96) = 145.28$ ,

$p < 0.001$ ,  $\eta^2 = 0.75$ . Posthoc analyses using Tukey's HSD revealed that on the MADRS, the manic group (mean = 10.42, S.D. = 5.77) differed significantly from the euthymic (mean = 1.6, S.D. = 2.91) and control (mean = 0.18, S.D. = 0.72) groups. The pattern was the same for the MAS, with a mean of 14.9 (S.D. = 6.6) for manic, 0.9 (S.D. = 1.4) for euthymic, and 0.2 (S.D. = 0.6) for control subjects. There was no statistical difference between euthymic and control groups regarding these two scales.

### 3.2. Valence evaluation

There was no group effect concerning the assessment of positive,  $F < 1$  and negative slides,  $F < 1$  (Fig. 1). There was a group effect only for the assessment of neutral slides,  $F(2, 96) = 9.2$ ,  $p > 0.01$ ,  $\eta^2 = 0.16$ . Post-hoc analyses using Tukey's HSD (see Table 1) revealed that the mean scores of the manic (mean = 5.3, S.D. = 1.3) and euthymic (mean = 4.7, S.D. = 1.1) groups were statistically different from those of the controls (mean = 4.0, S.D. = 1.3). Manic and euthymic patients expressed a more pleasant valence for neutral slides than controls.

### 3.3. Arousal evaluation

There was a group effect for the evaluation of all types of slides (Fig. 2). We found differences for positive ( $F(2, 96) = 9.7$ ,  $p < 0.001$ ,  $\eta^2 = 0.17$ ), neutral ( $F(2, 96) = 16.1$ ,  $p < 0.001$ ,  $\eta^2 = 0.25$ ) and negative ( $F(2, 96) = 5.8$ ,  $p < 0.001$ ,  $\eta^2 = 0.11$ ) slides.

The manic group showed higher mean arousal scores than the euthymic and control groups. Mean arousal scores for manic, euthymic and control subjects were, respectively, 5.5 (S.D. = 1.7), 4.0 (S.D. = 2), and 3.8 (S.D. = 1.4) for positive stimuli; 3.7 (S.D. = 2.3), 2.1 (S.D. = 1.7), and 1.3 (S.D. = 1.2) for neutral stimuli; and 6.3 (S.D. = 1.6), 4.9 (S.D. = 1.8), and 5.3 (S.D. = 1.7) for negative stimuli. All differences between manic and euthymic groups were significant (see Table 1). The manic group also differed significantly from the control group with regard to positive and neutral stimuli (see Table 1) and showed a strong tendency toward a difference for negative stimuli ( $p = 0.056$ ,  $d = 0.59$ ).

A series of complementary analyses was performed to rule out the possibility that some of our results could stem from initial differences between mixed states, manic states and hypomanic patients. One-way ANOVAs were performed to assess whether there were differences in the evaluation of arousal and valence among the three groups of patients. Regarding the evaluation of valence, there was

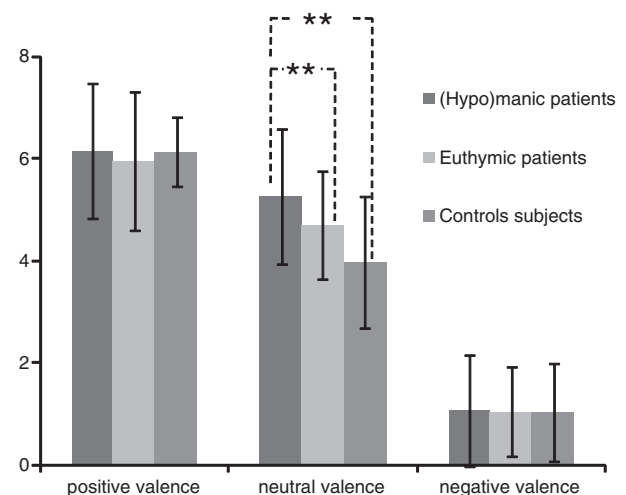


Fig. 1. Level of valence and arousal for manic or mixed states, euthymic bipolar patients and control subjects according to the types of slides. \*\*Differences between manic or mixed states and the other groups,  $p < 0.01$ .

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