



## Effects of emotion and identity on facial affect processing in schizophrenia

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### Abstract

We used facial affect labeling and matching tasks to study effects of (1) emotion and (2) identity on facial affect processing in patients with remitted schizophrenia ( $n=30$ ) compared with healthy controls ( $n=30$ ). The patients (1) had a specific deficit for labeling facial affects of sadness and anger but not happiness, disgust and fear; they (2) performed as well as controls in matching facial affects in one face but were impaired in matching facial affects in two different faces. The patients' impairment in facial affect processing may be emotion-specific. The effects of identity on facial affect processing are discussed in the light of several hypotheses (a deficit of context processing, a global–local processing impairment or a selective attention deficit), and may be related to frontal, prefrontal or amygdala dysfunctions.

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### 1. Introduction

It has been shown that perceiving affect in the faces of others is a fundamental skill that is defective in schizophrenia and may contribute to patients' poor

interpersonal and social functioning (Walker et al., 1984; Zuroff and Colussy, 1986; Borod et al., 1993; Hooker and Park, 2002). In general, individuals with schizophrenia are less expressive than controls in social situations (Aghevli et al., 2003; Shaw et al., 1999) and perform significantly worse than controls on almost all measures of facial affect perception (Edwards et al., 2002; Mandal et al., 1998). The Facial Affect tests developed by Kerr and Neale (1993) enable comparison between matching performances and analytical processing (verbal labeling) performance, respectively

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considered as right- and left-hemispheric functions. In matching paradigms, subjects are required to decide if two faces, presented successively (Facial Affect Recognition task: FAR) or simultaneously (Facial Affect Discrimination task: FAD), display the same affect. In the labeling paradigm (Facial Affect Identification task: FAI), subjects are asked to match faces with words in a list describing several possible facial affects. Compared with healthy controls, patients with schizophrenia exhibit deficits in the three tasks (Kerr and Neale, 1993; Salem et al., 1996; Penn et al., 2000).

Patients with schizophrenia also have subtle impairments in processing non-emotional facial features such as identity (Gessler et al., 1989; Archer et al., 1992, 1994; Kerr and Neale, 1993). Some experimental results suggest that facial affect recognition and face recognition performances are intercorrelated (Schweinberger and Soukup, 1998; Schweinberger et al., 1999; Baudouin et al., 2002). Moreover, the observation that both facial affect and facial identity processing are impaired in patients with schizophrenia leads to the question of whether emotion (relevant feature) and identity (context feature) have an effect on facial affect processing in schizophrenia.

This study aimed to test whether (1) emotion and (2) identity have an effect on FAR, FAD and FAI performance in remitted patients with schizophrenia compared with healthy controls. Following the literature, we expected that patients would perform less well than controls on all tasks. We hypothesized that (1) emotion and (2) identity would have a significant

impact on patients' performances in facial affect processing tasks.

## 2. Methods

### 2.1. Subjects

After approval of the research protocol by the ethical committee, informed written consent was obtained from all participants. Table 1 summarizes demographic and clinical characteristics of the 60 participants. Patients with schizophrenia ( $n=30$ ) were recruited at the Psychiatric Hospital "Le Vinatier" (Lyon, France), diagnosed according to DSM-IV criteria (American Psychiatric Association, 1994), and had no other concurrent diagnosis on axis I. Schizophrenia symptoms were assessed with the Scale for the Assessment of Negative Symptoms (SANS; Andreasen, 1983) and the Scale for the Assessment of Positive Symptoms (SAPS; Andreasen, 1984). Patients were clinically stable with no changes in medication for at least 1 month before the investigation. Control subjects ( $n=30$ ) were normal volunteers recruited within the hospital staff. They had to be free of DSM-IV axis I diagnoses. None of them had ever received antipsychotic medications.

For both groups, exclusion criteria were any major medical illnesses that could affect brain functioning, current substance abuse, neurological conditions,

Table 1  
Demographic and clinical characteristics of schizophrenia and control groups

	Patients with schizophrenia ( $n=30$ )		Healthy controls ( $n=30$ )		<i>P</i>
	Mean	S.D.	Mean	S.D.	
Age (years)	33.97	8.03	29.23	8.56	0.05
Sex (male/female)	19/11	–	20/10	–	NS
Educational level (years)	10.83	2.60	13.37	2.59	0.001
Age at onset (years)	25.82	6.16	–	–	–
Illness duration (years)	8.82	7.93	–	–	–
SANS score	61.60	22.43	–	–	–
SAPS score	43.76	25.02	–	–	–
Treatment (mg CPZ eq.)	423	390	–	–	–

SANS: Scale for the Assessment of Negative Symptoms (Andreasen, 1983).

SAPS: Scale for the Assessment of Positive Symptoms (Andreasen, 1984).

Mg CPZ eq: milligram equivalent chlorpromazine.

*P*: Between-groups comparisons with Student's *t*-tests.

recent history of head injury with loss of consciousness, visual difficulty and age below 18 or above 55.

## 2.2. Facial affect processing tasks

### 2.2.1. Facial photographs set construction

Stimuli were 25 original color photographs of five Caucasian men (mean age 25 years, range 23–27), each expressing five basic facial affects (Happiness, Sadness, Disgust, Fear and Anger). Fifteen healthy individuals (who did not belong to the control group of the study) matched these photographs with one of the following words describing facial affect: Happiness, Sadness, Disgust, Fear, Anger and Other (the last choice was added to avoid elimination strategies, which would not gauge facial affect processing). A minimum of 65% of agreement was required to ensure that the selected photograph was really representative of the expected affect.

### 2.2.2. Choice of the exposure time for photographs

The exposure times were chosen according to the procedure of Baudouin et al. (2002). It has been shown that healthy subjects can process facial information (including identity, gender, age and affect) in fewer than 400 ms (Krolak-Salmon et al., 2001). Thus, a minimum of 1000 ms was chosen for the exposure time (for the first photograph in the FAR task), to take into account the fact that patients may have slower information processing.

### 2.2.3. Facial affect processing tasks

**2.2.3.1. FAR task.** In the FAR task, two facial photographs were successively presented on a computer screen in a random order with a delayed matching paradigm. Both affects and identities of the faces could be either identical or different, leading to four different conditions (condition 1: same facial affects and facial identities; condition 2: same facial affects and different facial identities; condition 3: different facial affects and same facial identities; and condition 4: different facial affects and different facial identities). Eighty trials were performed (20 trials per condition). For each trial, one photograph appeared on the left side of the screen over 1000 ms and was followed, after a 500-ms delay, by a second photograph on the right side of the screen. The second

photograph remained on the screen until the subject had answered. Subjects were required to judge whether the second face displayed the same or a different affect from the first. They were asked to answer as quickly and as accurately as possible.

**2.2.3.2. FAD task.** In the FAD task, the same pairs of facial photographs were presented in random order leading to the same four conditions, but with a non-delayed matching paradigm, i.e., the two photographs appeared simultaneously. Stimuli were maintained on the screen until the subject answered.

**2.2.3.3. FAI task.** In the FAI task, the same photographs were presented one by one, in a random order with a verbal labeling paradigm. Each photograph appeared on the left side of the screen, and the right side contained the words: “Happiness”, “Sadness”, “Disgust”, “Fear” and “Anger”. Subjects were required to match the photograph to the word that best described the facial affect, with no time limitations on task completion. The FAI task was the last one to be completed to avoid facial affect identification during the first two tasks.

### 2.2.4. Procedure

The effects of emotion (1) on performance were assessed with the FAI paradigm, whereas the effects of identity (2) on performance were assessed with the FAR and FAD tasks.

## 2.3. Statistical analysis

The percentage of correct responses (CR) was recorded for the three tasks (Table 2). Between-group comparison for gender differences (chi-square test) was not significant ( $\chi^2=0.07$ ,  $df=1$ , NS). Between-group comparison for age and education level by *t*-test showed a significant difference for age ( $t=2.21$ ,  $P<0.05$ ) and educational level ( $t=-3.78$ ,  $P<0.001$ ).

Despite the lack of data concerning a potential influence of these variables on facial affect processing, we performed multivariate analyses of covariance (MANOVAs), with age and educational level as covariates. Factors in the analyses were “Group” (patients with schizophrenia vs. healthy controls), “Task” (FAR vs. FAD vs. FAI), “Facial affect similarity” (identical or different facial affects),

Table 2

Performances of patients with remitted schizophrenia and healthy controls on the FAR, FAD and FAI tasks

		Patients with schizophrenia ( <i>n</i> =30)		Healthy controls ( <i>n</i> =30)		<i>P</i>
		Mean	S.D.	Mean	S.D.	
Percentage of correct responses	FAR	74.96	8.49	84.91	4.90	<0.0005
	FAD	77.83	8.67	86.46	5.21	<0.005
	FAI	60.13	11.48	76.4	11.08	<0.005

Patients performed significantly worse than controls in the three facial affect processing tasks.

FAR: Facial Affect Recognition.

FAD: Facial Affect Discrimination.

FAI: Facial Affect Identification.

*P*: Between-group comparisons with Student's *t*-tests.

“Facial identity similarity” (identical or different facial identities) and “Emotion category” (Happiness, Sadness, Disgust, Fear or Anger). The first one is a between-subjects factor and the four others are within-subjects factors. The dependent variables were percentage of correct responses (CR).

To confirm a deficit in facial affect processing in remitted schizophrenia, the performances of schizophrenia patients and healthy controls on the FAR, FAD and FAI tasks were compared in a 2 (Group) by 3 (Task) MANOVA. Effects of the factors Group (i.e., patients or control subjects) and Task (i.e., FAR, FAD and FAI tasks) were tested on the mean correct responses.

To test whether emotion had an effect on facial affect processing performance, a 5 (Emotion category) by 2 (Group) MANOVA was performed. The effects of two factors were tested: Emotion category (Happiness, Sadness, Disgust, Fear or Anger) and Group (Patients or control subjects).

To test whether identity had an effect on facial affect processing performance, the effects of facial identity similarity on FAR and FAD performances were analyzed with a 2 (Group) by 2 (Task) by 2 (facial identity similarity) by 2 (facial affect similarity) MANCOVA. The effects of the following four factors on correct responses were tested: Group (i.e., patients or control subjects); Task (i.e., FAR or FAD task); Facial affect similarity (i.e., identical or different facial affects); and Facial identity similarity (i.e., identical or different facial identities).

Finally, Spearman's correlation coefficients were calculated between performances and clinical characteristics (e.g., duration of illness, age at onset, and SANS and SAPS scores).

All of these analyses were conducted with Statistica® software. Statistical significance set at 0.05 was followed by planned comparison using Student's *t*-tests. Results are expressed as means ± S.D.

### 3. Results

Descriptive statistics are presented in Table 2. A 2 (Group) by 3 (Task) MANOVA with age and educational level as covariates was conducted on the mean FAR, FAD and FAI scores. The multivariate effects of Group [ $F(1,58)=46.30$ ,  $P<0.0001$ ] and Task [ $F(2,116)=69.90$ ,  $P<0.0001$ ] as well as the Group by Task interaction [ $F(2,116)=5.24$ ,  $P<0.01$ ] were significant. Patients with schizophrenia had significantly lower correct response scores (CR) than healthy controls (Table 2) in all three tasks [ $F(2,116)=69.90$ ,  $P<0.0001$ ; FAR task:  $F(1,56)=13.67$ ,  $P<0.0005$ ; FAD task:  $F(1,56)=11.96$ ,  $P<0.005$ ; FAI task:  $F(1,56)=19.72$ ,  $P<0.0001$ ].

#### 3.1. Does emotion have an effect on facial affect processing in patients with remitted schizophrenia?

A 5 (Emotion category) by 2 (Group) MANCOVA was performed on the labeling task (FAI) with age and educational level as covariates. The multivariate effects for the Group and Emotion category factors were significant [respectively:  $F(1,58)=31.17$ ,  $P<0.001$  and  $F(4,232)=44.91$ ,  $P<0.0001$ ]. The Group by Emotion category interaction was significant [ $F(4,232)=3.98$ ,  $P<0.005$ ]. Happiness gave rise to the highest FAI score, and no significant group difference was found for this emotion [ $F(1,56)=1.68$ , NS]. Likewise (Table 3), the

Table 3  
Mean percentage of correct responses in the FAI task as a function of emotion category

	Emotion category	Patients with schizophrenia		Healthy controls		<i>P</i>
		Mean	S.D.	Mean	S.D.	
Percentage of correct responses	Happiness	98.67	5.07	98.67	7.30	NS
	Sadness	50.67	27.16	80.66	19.28	<0.001
	Fear	55.33	28.13	71.33	26.62	NS
	Anger	53.79	26.78	80.71	18.44	<0.005
	Disgust	40.67	19.29	57.86	22.67	NS

Patients with schizophrenia are significantly impaired in identifying facial affects of sadness and anger, but not others.

NS: Not significant, i.e.,  $P > 0.05$ .

*P*: Between-group comparisons with Student's *t*-tests.

effect of Group for Fear and Disgust was not significant [Fear:  $F(1,56)=2.63$ , NS; Disgust:  $F(1,56)=0.50$ , NS], whereas it was significant for Sadness [ $F(1,56)=19.20$ ,  $P < 0.0001$ ] and Anger [ $F(1,56)=8.95$ ,  $P < 0.005$ ].

### 3.2. Does identity have an effect on facial affect processing in patients with remitted schizophrenia?

A 2 (Group) by 2 (Task) by 2 (facial identity similarity) by 2 (facial affect similarity) MANCOVA was conducted on the two matching tasks (FAR and FAD) with age and educational level as covariates. There was a significant main effect of Group [ $F(1,58)=29.37$ ,  $P < 0.0001$ ]. Patients performed significantly worse than controls (respectively: 76.40% ± 8.63 and 86.69% ± 5.08 correct responses).

The main effect of Task was significant [ $F(1,58)=13.19$ ,  $P < 0.001$ ]. Scores were lower for the FAR than for the FAD task (79.94% ± 8.51 vs. 82.15% ± 8.32 correct responses).

The “facial identity similarity” factor effect was significant [ $F(1,58)=153.20$ ,  $P < 0.0001$ ]; changing facial identity had a detrimental effect on subjects' performances (90.62% ± 14.02 correct responses for matching facial affects in one face vs. 71.46% ± 25.32 for matching facial affects displayed by different faces).

Lastly, the Facial affect similarity effect was significant [ $F(1,58)=8.00$ ,  $P < 0.01$ ]. Scores were lower for matching identical facial affects than for different ones (77.25% ± 27.59 vs. 84.83% ± 15.24 correct responses).

Table 4  
Rates of correct responses of patients with remitted schizophrenia and healthy controls in the FAR and FAD tasks as a function of the condition

Condition		1		2		3		4	
		Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Facial affects	Same			Same		Different		Different	
	Different			Different		Same		Different	
Facial identities	Same			Different		Same		Different	
	Different			Same		Different		Same	
FAR task (delayed matching)	Patients with schizophrenia	92.67	12.16	46.17	28.03	80.83	15.92	80.17	18.68
	Healthy controls	98	6.10	67.5	17.60	88.5	8.00	85.67	7.74
<i>P</i>		NS		<0.05		NS		<0.05	
FAD task (delayed matching)	Patients with schizophrenia	96.83	4.45	54.6	27.76	78.83	24.95	83.5	17.13
	Healthy controls	99	2	70	12.55	90.33	7.06	90.83	7.78
<i>P</i>		NS		<0.05		NS		<0.05	

Significant differences between groups are observed with different facial identities only (conditions 2 and 4).

FAR: Facial Affect Recognition.

FAD: Facial Affect Discrimination.

*P*: Between-groups comparisons with Student's *t*-tests.

The Facial identity similarity by Facial affect similarity interaction and the Group by Facial identity similarity by Facial affect similarity interaction were significant [ $F(1,58)=165.49$ ,  $P<0.001$ ;  $F(1,58)=7.64$ ,  $P<0.01$ , respectively]. Probing of the Group by facial affect similarity by Facial identity similarity interaction revealed a significant effect of Group when facial identities were different [patients:  $63.67\% \pm 29.78$  of correct responses; controls:  $77.42\% \pm 28.94$ ;  $F(1,58)=241.78$ ,  $P<0.0001$ ], but not when facial identities were similar [patients:  $89.22\% \pm 17.69$  of correct responses; controls:  $93.96\% \pm 17.67$ ;  $F(1,58)=2.57$ , NS]. Actually (see Table 4), patients with remitted schizophrenia performed as well as controls for matching facial affects in one face (conditions 1 and 3), whereas they performed worse than controls for matching facial affects displayed by two different faces (conditions 2 and 4).

### *3.3. Is there a correlation between facial affect processing and clinical characteristics in patients with schizophrenia?*

No significant correlation was found between performance on facial affect processing tasks and clinical characteristics (e.g., illness duration, age at onset, SANS and SAPS scores, and antipsychotic dose).

## **4. Discussion**

This study has two emerging findings. The first is that (1) the deficit of patients with remitted schizophrenia for processing facial affects concerns only facial emotions of sadness and anger and the second is that (2) irrelevant information about facial identity may have an effect on facial affect processing performances in patients with remitted schizophrenia.

However, some methodological limitations should be taken into account. First, a difference in age and educational level between the two groups could account for differences in performance (Edwards et al., 2002). Nonetheless, statistical analyses did not reveal any influence of age or educational level on performance, whatever the group. Moreover, Bryson

et al. (1997) showed that demographic characteristics (e.g., age and educational level) had no effect on subjects' performances for facial affect processing. Second, patients received various antipsychotic medications at the time of assessment. However, many reports have shown that deficits in facial affect processing were not a consequence of antipsychotic treatment (Earnst et al., 1996; Gaebel and Wölwer, 1992; Mueser et al., 1997). In addition, statistical analyses did not reveal any significant relationship between antipsychotic dose and FAR, FAD or FAI performances in the present experiment.

As suggested in the literature, facial affect processing deficits may be a trait aspect of schizophrenia (Gaebel and Wölwer, 1992; Mikhailova et al., 1996; Streit et al., 1997; Waldeck and Miller, 2000; Wölwer et al., 1996). Consistent with this, patients with remitted schizophrenia had low scores on all facial affect processing tasks. Moreover, the trait-like hypothesis is also supported by evidence of deficits for facial affect processing in schizotypal personality disorder and in schizophrenic patients' first degree relatives (Edwards et al., 2001; Poreh et al., 1994; Streit et al., 2001a,b; Wölwer et al., 1996). Nevertheless, the extent to which FAR, FAD and FAI deficits are related to schizophrenia vulnerability markers remains to be tested.

Impaired processing of facial affects has also been reported by others in amygdalectomised patients (Young et al., 1995, 1996) and right-brain-damaged patients (Borod et al., 1993). This is consistent with many reports that have implicated the amygdala in the processing of emotion (Adolphs et al., 1996; Adolphs, 1999; Kosaka et al., 2002; Young et al., 1996). We note that this region has also been proposed as a critical structure in the cognitive dysfunction of patients with schizophrenia (Evangeli and Broks, 2000). Other cerebral structures like the frontal and prefrontal cortex were reported to be activated in facial information processing (Guillaume and Tiberghien, 2001). Furthermore, their direct electrical stimulation evoked hallucination of faces (Vignal et al., 2000). Elsewhere, these same regions have been reported to be associated with cognitive dysfunctions in patients with schizophrenia (for a review, see Mitchell et al., 2001). These observations are in accordance with the hypothesis that abnormalities in

frontal, prefrontal and temporal (amygdala) functioning in schizophrenia could underlie impairments in both clinical and cognitive areas, especially facial affect processing.

#### *4.1. Facial emotion has an effect on facial affect processing in patients with remitted schizophrenia*

This study demonstrates that FAI performance is impaired in schizophrenia, particularly identification of facial emotions of sadness and anger. Consistent with previous reports, happiness was the easiest to recognize and the lack of differences between groups on this emotion may be attributable to a ceiling effect (for review, see Edwards et al., 2002; Phillips et al., 2003a,b; Posamentier and Abdi, 2003). However, there was not a significant difference between groups on disgust identification, although this emotion was the hardest to recognize. Thus, these data support the hypothesis of an emotion-specific deficit for facial affect identification and a greater sensitivity toward negative emotions in patients with schizophrenia.

#### *4.2. Facial identity has an effect on facial affect processing in patients with remitted schizophrenia*

There is growing evidence of an influence of facial identity on facial affect processing in healthy controls (Bobes et al., 2000; Etcoff, 1984; Schweinberger et al., 1999). The present results confirmed these findings with the FAR task and extended them to FAD abilities. In addition, our results also revealed that the influence of facial identity on facial affect matching is stronger in patients with schizophrenia than in healthy controls, and that the difference between patients and controls may also be stronger in matching identical facial affects than different ones. Patients performed worse than controls only when affects were presented by two distinct faces just as if they were not able to ignore facial identity while processing facial affect.

Such a pattern of performance may be seen as a difficulty to extract the relevant information (e.g., facial emotion) from the context (e.g., facial identity). Previous studies attempted to propose that various cognitive dysfunctions observed in schizophrenia may be related to impairment in processing

contextual information (Servan-Schreiber et al., 1996). Another hypothesis has been proposed by Baudouin et al. (2002), who demonstrated that a selective attentional deficit could account for impaired facial affect processing in patients with schizophrenia. These authors compared patients with schizophrenia and healthy controls on two tasks. In the first task (identity matching), subjects were asked to match faces expressing different affects according to their identity (face recognition task). In the second task (emotional matching), subjects were required to match faces with different identities according to their facial affect. Patients had difficulty in processing facial affects while ignoring facial identity (emotional matching), whereas they could accurately process facial identity while ignoring facial affects (identity matching). Consistent with this, a relation between attention and affect processing in schizophrenia has been previously reported (Addington and Addington, 1998). A third hypothesis can be considered since identity is accessible from global processing whereas affect recognition requires local processing. Thus, a deficit in global–local processing in patients with schizophrenia (Loughland et al., 2002) may also explain the patients' pattern of results.

However, these three hypotheses are not contradictory since in our tasks facial affect can be considered as relevant information requiring local processing whereas facial identity pertains to the context and requires global processing.

#### *4.3. Deficits in FAR, FAD and FAI performance do not correlate with patients' clinical characteristics*

Congruent with recent findings (Loughland et al., 2002; Silver and Shlomo, 2001), no significant correlation was found between facial affect processing performances and clinical characteristics of patients (e.g., symptom scores on SANS and SAPS scales, antipsychotic dose, illness duration, age at onset). However, this is discordant with previous researches (Kohler et al., 2000; Mandal et al., 1999; Penn et al., 2000; Shaw et al., 1999; Silver et al., 2002). There are several possible explanations for the absence of significant correlation. First, the clinical heterogeneity of the patient group (S.D. for SAPS score=25.06 and S.D. for SANS score=22.43)

may have led to underestimated correlations. Second, it is likely that correlations between facial affect processing and negative symptoms are only significant during the acute phase of the illness and not during the remission stage (Penn et al., 2000).

In the future, researchers searching for relationships between cognitive and clinical variables may divide schizophrenia patients into two subgroups on the basis of positive and negative symptom scores, and they also may test patients twice: during an acute phase and after remission.

#### 4.4. Conclusion

In remitted patients with schizophrenia, facial affect processing deficit is emotion-specific (sadness and anger). Moreover, patients are more disturbed by context information (identity of the face) than healthy subjects. This pattern of performance may be a consequence of an impaired context processing, a selective attentional deficit or a global–local processing impairment, probably related to cerebral dysfunctions. Correlations between facial affect processing, cognitive dysfunctions, clinical characteristics, and brain functioning need to be further investigated.

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