Facial emotion recognition in schizophrenia: an event-related potentials study

Riconoscimento delle espressioni facciali: uno studio con potenziali evento-correlati

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SUMMARY. Previous studies extensively reported an impaired ability to recognize emotional stimuli in patients with schizophrenia. We used pictures from Ekman and Friesen in an event-related potentials study to investigate the neurophysiological correlates of the fear emotional processing compared with happiness in patients with schizophrenia versus healthy subjects. A significant lower P300 amplitude for fear processing but not for P100, N170 and N250 amplitude was found in schizophrenics compared to controls. These data suggest that the ability of basic visual processing is preserved in schizophrenia, whereas facial affect processing is impaired.

KEY WORDS: Emotion recognition, schizophrenia, event-related potentials.

RIASSUNTO. Studi precedenti hanno ampiamente documentato una compromissione della capacità di riconoscimento degli stimoli emotivi nei pazienti affetti da schizofrenia. In questo studio con potenziali evento-correlati sono state utilizzate alcune immagini di volti tratte da Ekman e Friesen per valutare i correlati neurofisiologici del processa mento delle emozioni di paura e felicità in pazienti schizofrenici confrontati con una popolazione di controllo. Un'ampiezza della P300 significativamente inferiore per l'elaborazione della paura è stata riscontrata nei pazienti schizofrenici rispetto ai controlli. Questi dati suggeriscono che i pazienti con disturbo schizofrenico, a fronte di una capacità di elaborazione visiva inalterata, presentano un deficit nel riconoscimento dell'espressione facciale.

PAROLE CHIAVE: Riconoscimento emotivo, schizofrenia, potenziali evento-correlati.

INTRODUCTION

Facial emotion recognition ability is an important component of the nonverbal communication system and an essential skill for successful adaptation and manipulation of the environment. Abnormal recognition of emotional facial expressions is considered a critical factor for poor communication and alterations of adaptive behavior. Indeed, recognition emotion deficit is considered to be strictly involved in psychiatric disorders[1].

Several studies demonstrated that individuals with schizophrenia have more difficulties in identifying negative than positive facial emotions[2,3]. Other studies pointed out that schizophrenic patients show a generalized deficit in the recognition of both positive and negative emotions[4,5].

Whether the emotional processing of fear compared with happiness stimuli is specifically related to facial emotions recognition or to a more generalized deficit remains an unsolved issue.

The neurophysiological instrument of event-related potentials (ERPs) can help to explain this issue, because it is well suited to examine the timing of processes involved in face perception and facial expression analysis. In the temporal domain, evoked-potentials show four ERP components that are related to facial affect processing: the P100 reflecting the basic visual processing, the N170 reflecting the structural encoding stage, the N250 reflecting facial affect processing, and the P300 reflecting sustained selective attention directed to motivationally relevant input. Deficits in the P300 ERP have been reported in schizophrenia, including the early stages of the illness[6-12] and have been studied as promising candidate endophenotype of schizophrenia[13-15]. Several studies[3,16] showed that P300 amplitudes generated by negative emotional target were significantly smaller than those generated by positive stimuli in patients with schizophrenia. Moreover, several studies have found that schizophrenia patients exhibit reduced N170 amplitude during face and facial affect processing[16,17] suggesting that schizophrenia

patients' deficits in emotion decoding are due to deficits in structural encoding of facial features.

The aim of the present study was to examine the temporal dynamics of emotional face recognition in schizophrenic patients. Fearful expressions were chosen because they are salient emotional stimuli, as demonstrated by modulations of the cortical region via the amygdala during fear perception[18].

METHODS

Twenty-six stable patients with schizophrenia (20 female, 6 male; mean age: 33.80 ± 11.34 years), and 22 healthy subjects (17 female, 5 male; mean age: 33.71 ± 9.22 years), volunteered to participate in the study. All subjects were right-handed.

The clinical subjects were recruited if their current diagnosis according to the DSM-IV (American Psychiatric Association, 2000) criteria was schizophrenia on the basis of clinical interview of senior staff psychiatrists (PS, AR). Exclusion criteria included visual difficulty, history of neurological illness or trauma, alcohol or drug dependence according to the DSM-IV criteria.

All patients were receiving antipsychotic therapy provided by the Mental Health Centre of L'Aquila. All subjects provided written informed consent after a complete description of the study, according to the local institutional review board.

Electroencephalographic activity was acquired from three scalp electrodes attached to the midline frontal (Fz), central (Cz) and parietal (Pz) regions positioned according to the international 10-20 system with a reference electrode on linked ears. The electro-oculogram (EOG) was recorded from an electrode located laterally at the supraorbital ridge of the right eye referenced to an electrode located laterally below the left eye. Eye movement artifacts were excluded from the analysis. The inter-electrode impedances were always <5 kΩ in each subject investigated.

Black and white photographs of a man's face adopting three basic emotional expressions (i.e. happy, fear and neutral) have been taken from the Ekman and Friesen (1976) archive.

During the recording period, the subjects had to look at faces of a person showing neutral (frequent stimulus, f.s.) and emotional expressions (happy and fear as target stimuli, t.s.). The faces were shown repeatedly and each was displayed for 200 ms with an interstimulus interval of 800 ms. Each sequence consisted of a pseudo-random series of stimuli. Every block comprises 250 images with a ratio 4:1 for frequent and deviant random stimuli. The task consisted of two runs: in the first run, the subjects looked at the neutral faces (f.s.) and happy faces (t.s.); in the second run, they looked at the neutral faces (f.s.) and fear faces (t.s.). In this paradigm, the subjects were asked to respond quickly and accurately by pressing a button with the right hand when they detected a rare visual stimulus.

To examine the differences between schizophrenic and healthy subjects, peak amplitudes and latencies of P300 and the other ERP component in Fz and Pz channel for happy and fear pictures were submitted to a mixed model ANOVA with *Group* (Schizophrenic vs Healthy) as between factor, and *Emotion* (Happy vs Fear) and *Component* (Fz vs Pz) as within factors.

RESULTS

Regarding latency, the results from the ANOVA on the P100 data did not reveal main effects of the Group, Emotion and Component (p=0.34, 0.14 and 0.35, respectively). None of the interactions approached statistical significance. Analysis of N170 peak latency revealed a main effect of the Group ($F_{1,45}$=15.96; p<0.0002) but no significant main effect for Emotion (p=0.11) or Component (p=0.30) and significant interactions. The N170 latency in schizophrenic patients was longer than that in healthy subjects.

The analysis of the N250 and P300 peak latency revealed no main effects or interaction.

Regarding the amplitude, in the analysis of P100 activity there was no main effects but the Group x Component interaction was significant ($F_{1,45}$=10.91, p<0.001). Analysis of the N170 activity showed only the Emotion x Component interaction ($F_{1,45}$=4.28, p<0.04) and analysis of the N250 latency revealed no significant main effect for Group, Emotion and Component and no significant interactions. ANOVA results on the P300 data revealed a significant main effects for Group ($F_{1,45}$=6.58, p<0.01) and Emotion ($F_{1,45}$=6.31, p<0.01) and there was a significant interaction between Group and Emotion ($F_{1,45}$=11.40, p<0.001). The P300 amplitude in schizophrenia was lower than in healthy subjects in response to Emotion (Happy and Fear) but was significantly lower in response to fear emotion compared to happy emotion. Figure 1 shows the average amplitude for the N170 and P300 response of each emotion for each group.

DISCUSSION

Our results suggest that the ability of basic visual processing is preserved in schizophrenic patients whereas facial emotion recognition is dysfunctional.

These data show that schizophrenic patients differed from the control group in the P300 amplitude but exhibited normal P100, N170 and N250 amplitudes that reflect basic encoding, visual processing and affect decoding of facial features, respectively. No relevant differences were observed in ERP component latency confirming that while the findings on ERP amplitude in schizophrenia were solid, latency measurements of the ERP component revealed inconsistent results[19].

In our study, the amplitude of P300 elicited by negative emotional stimuli was significantly smaller than that elicited by positive stimuli in schizophrenic patients compared to control subjects. On the other hand, no significant difference in P300 latency was observed for positive and negative emotional block in the control and patient groups. Along this line, our data are consistent with those of An et al.[3] that show decreased P300 amplitude in schizophrenia in response to negative emotion. The current finding indicates that negative facial emotions induced less engagement of the neural processor underlying P300 than positive stimuli.

Although previous studies reported N170 amplitude deficits in schizophrenic patients during processing emotional faces[16,17,20], but we are unable to confirm this finding similarly to Streit et al.[21], and Wynn et al.[22]. Likewise, we did not find any P100 and N250 amplitude differences suggesting that the ability of basic visual processing and facial affect processing are preserved whereas facial emotion recognition is dysfunctional.

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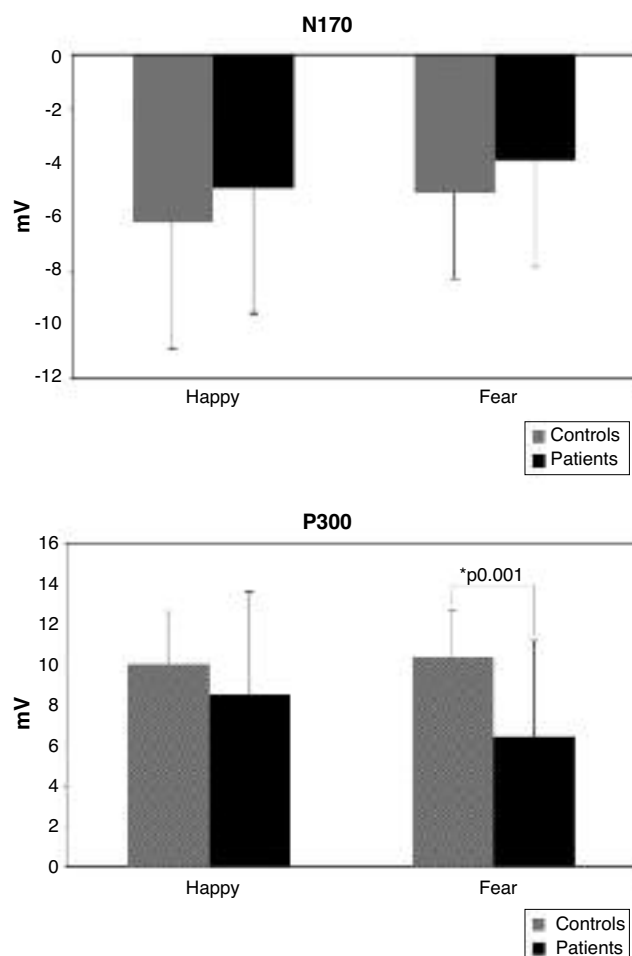

Figure 1. Average amplitude of each emotion (happy and fear) for each Group (controls and patients). Data for the N170 response are reported in the top panel, and data for the P300 response are reported in the bottom panel.

As a matter of fact, the facial affect recognition impairment in schizophrenic patients suggested by reduced P300 amplitude is not attributable to deficits in the basic visual processing or facial feature encoding stage. Moreover, this neurophysiological evidence demonstrates that patients with schizophrenia have stronger deficits in negative than in positive emotion recognition processing. This could be related to social withdrawal, which is one of the typical symptoms in schizophrenia. Repeated withdrawal from a negatively arousing context may result in a more profound impairment of negative emotion recognition[3,23].

A further correlate of facial emotion recognition impairment in individuals with schizophrenia is poor social functioning[24].

In conclusion, our data confirm that schizophrenia persons are neurophysiologically different from healthy subjects in terms of facial emotion recognition processing. We suggest that ERP components sensitive to emotional expressions can potentially be investigated as a biomarker in schizophrenia.

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