

# Perception of facial affect in chronic schizophrenia and right brain damage

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**Abstract.** This study was designed to compare the performance of 50 chronic schizophrenics (CS) to that of 30 right brain-damaged patients (R), and 50 healthy controls (N) on several facial perception measures: Emotion Labelling and Recognition, and the Benton Facial Recognition Test. CSs were diagnosed according to DSM-IV criteria and their psychiatric state was assessed using the PANSS scale. All subjects were right handed. Their cognitive state was assessed using the MMSE. Subjects rated their current mood on a visual analogue scale. The results showed that the CSs and Rs were significantly impaired compared to Ns for the emotional tasks but did not differ from each other. Moreover, the patient groups were significantly less accurate in recognising emotionally neutral facial stimuli. Each subject group had more difficulty processing negative relative to positive affect. The deficit in schizophrenia was found to be stable, which may reflect a trait-like, rather than a state-dependent, characteristic. Moreover, some support is provided for the notion that facial affect perception in chronic schizophrenia is associated with right hemisphere dysfunction.

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## INTRODUCTION

Over the last few decades there have been numerous studies examining the perception of human affect in normal and pathological populations (Izard 1971, Novic et al. 1984, Schapkin et al. 2000). However the neural correlates of emotional and facial processes are not clear cut and need further investigation.

Perception of facial emotion is thought to be a complex cognitive ability which relies on the integrity of a select set of more basic neurocognitive processes such as visual scanning, working memory, and vigilance which may be asymmetrically distributed across the cerebral hemispheres (Kee et al. 1998).

Before turning to schizophrenia and right brain damage, it is important to explore two main theories regarding hemispheric specialisation for emotion: 1) the right hemisphere theory, and 2) valence theory. The first theory suggests the dominance of the right hemisphere in the perception of emotions. It assumes that the structures that analyse both positive and negative emotions are linked solely to the right hemisphere (Borod et al. 1983, 1988, David and Cutting 1990). The second hypothesis points to the differentiated specialisation of each hemisphere in the regulation of emotions (Reuter-Lorenz and Davidson 1981, Bryden et al. 1982): the right hemisphere controls negative emotions while the left mediates positive affect (Silberman and Weingartner 1986).

The bulk of the research in this area has suggested that facial affect is perceived by the right cerebral hemisphere (Borod et al. 1983, 1988, Borod 1992). This notion is supported by the findings that right brain-damaged patients are significantly less accurate in decoding of both positive and negative affect compared to left brain – damaged patients and healthy controls (Bowers et al. 1985).

On the other hand, there is also evidence from the literature supporting the valence hypothesis (Borod et al. 1986, Mandal 1987, Mandal et al. 1998).

Studies by Borod et al. (1993) on schizophrenics and patients with right hemisphere damage showed that deficits in the perception of facial emotions were present to an equal degree in both groups of patients.

A deficit in emotional perception in schizophrenics has been reported by numerous authors (Walker et al. 1984, Feinberg et al. 1986, Borod et al. 1993, Kerr and Neale 1993). However, as yet the precise implications of this are unclear. Studies carried out in the last decade all found a general cognitive deficit in schizophrenics but in addition a specific emotional deficit, usually in the

context of affect processes (Borod et al. 1993, Kerr and Neale 1993, Salem et al. 1996). In support of this are studies showing that schizophrenia patients have a generalised performance deficit encompassing all facial emotions but also nonemotional faces which might suggest right cerebral hemisphere dysfunction (Novic et al. 1984, Feinberg et al. 1986, Archer and Hay 1992, Heimberg et al. 1992). However, according to other studies schizophrenics appear to have a specific difficulty with perceiving facial emotions, especially negative emotions (Muzekari and Bates 1977, Mandal 1987, Cramer et al. 1989).

The question of the stability and durability of deficits in emotion perception still remains open. This study represents only the beginning of an attempt to consider the diversity and complexity of this problem. To date, the link between the deficit in emotional perception and psychopathology has not been confirmed in schizophrenia. The stability of such a deficit has been shown in one longitudinal study (Gaebel and Wölwer 1992). Further research examining the background of deficits in the perception of facial emotions is needed.

The current study is an outgrowth of studies examining hemispheric differences in decoding of facial affect in relation to neurological disorder.

The goals of this study were: 1) to determine the extent and nature of deficits in the perception of facial affect in patients with schizophrenia and right brain damage, 2) to determine the relation of such deficits to patients' age, sex, education, current mood, cognitive functioning, duration of illness, severity of psychopathology, and neuroleptic dose, 3) to clarify whether patients' deficiency in the perception of affect is due to impairments of emotional processes or whether it reflects a more generalised cognitive dysfunction, 4) to investigate the hypothesis of dissociation between perception of facial affect and unfamiliar face matching and, 5) to evaluate the performance on tests measuring perception of positive and negative emotions (effect of valence).

## METHODS

### Subjects

Subjects were 50 chronic schizophrenic (CS) inpatients (26 males; 24 females) from Lublin University Psychiatric Hospital, 30 right brain-damaged patients (R) included 17 males and 13 females. Fifty healthy con-

Table I

Demographic and clinical data for the 3 subject groups: chronic schizophrenics (CS), right brain-damaged patients (R), and normal controls (N)

Variable	Measure	CS	R	N	<i>F</i>	dF	<i>P</i>
Age	years	41.6 ± 10.3	56.7 ± 10.5	36.8 ± 13.4	31.1	2	<0.001
Education	years	12.3 ± 3.4	12.0 ± 2.8	13.5 ± 3.0	2.45	2	0.09
Duration of illness	years	13.2 ± 6.6	-	-	-	-	-
Number of hospitalisations	No	4.6 ± 2.8	-	-	-	-	-
Neuroleptic dose	CPZE, mg/day	383 ± 131	-	-	-	-	-
PANSS-P	"positive symptom" subscale	11.7 ± 3.5	-	-	-	-	-
PANSS-N	"negative symptom" subscale	26.0 ± 5.5	-	-	-	-	-
PANSS-G	"general psychopathology" subscale	34.6 ± 6.8	-	-	-	-	-
Mood	0 – the saddest, to 100 – the happiest	56.9 ± 2.5	52.0 ± 17.7	62.8 ± 15.1	3.47	2	<0.05
MMSE	scorable responses (max = 30)	26.2 ± 1.6	26.0 ± 2.0	29.4 ± 1.0	64.6	2	<0.001
Benton test	scorable responses (max = 54)	39.5 ± 5.0	37.8 ± 4.8	45.0 ± 4.4	26.5	2	<0.001

Data expressed as ± SD. *P*, statistical significance in one-way ANOVA groups comparison; *F*, ratio of between groups variations.

trol subjects (N) (24 males, 26 females) participated in the study after informed consent was obtained (see Table I).

Schizophrenic patients met DSM-IV diagnostic criteria for schizophrenia on the basis of clinical interview. Inclusion criteria for schizophrenic patients comprised: clinical stability (the assessment was performed after 4 weeks of neuroleptic treatment), and age between 18-65 years.

All subjects were screened to exclude secondary neurological disorders (e.g. epilepsy, dementia), habitual drug or alcohol abuse, mental retardation, and vision or hearing impairment.

All schizophrenic patients were taking neuroleptics. The mean daily dose in chlorpromazine equivalents (CPZE) was 383 ± 131 mg. Four schizophrenics who volunteered to take part in the study were not included in the final sample because either they were unable to complete the full set of tests due to akathisia (two) or they were discharged before completing the three experimental sessions (two).

The inpatients with right hemisphere damage (R) were recruited from the neurology wards of the Lublin Medical Center. Brain-damaged subjects were included if they had experienced a single episode cerebrovascular accident (hemorrhagic infarct or ischemic stroke) localised in the right hemisphere (Table II). The cause of the stroke was thromboembolic in 25 patients (84%) and hemorrhagic in 5 patients (16%). Confirmation of the diagnosis was made according to WHO criteria by a neurologist not involved in the study. Also CT scans were required to confirm the unilateral nature of the lesions. We excluded patients with TIAs, cerebral haemorrhage, subarachnoid haemorrhage and previous cerebrovascular event caused a persistent neurological deficit. The neurological patients were assessed at least 4 weeks after stroke onset.

The control subjects were recruited from the non-professional staff at Lublin University Medical School and Lublin Psychiatric Hospital. None had a history of organic central nervous system disorder or psychiatric disorder. The cognitive state of subjects was assessed by

Table II

Lesion distribution in right brain-damaged patients (R)		
R		
%	N	Location
16.6	5	Frontal
26.6	8	Parietal
13.3	4	Frontoparietal
20.0	6	Frontotemporal
13.3	4	Temporal
3.3	1	Occipital
6.6	2	Subcortical grey structures (basal ganglia, thalamus)

means of the Mini Mental State Examination (Folstein et al. 1975). An inclusion criterion for all subjects was a minimum score of 23 on the MMSE. All subjects were classified as right handed (Annett 1970).

### Procedure

#### *THE POSITIVE AND NEGATIVE SYNDROME SCALE (PANSS) (Kay et al. 1987)*

This 30-item symptom rating scale consists of three subscales (positive symptoms scale, negative symptoms

scale, general symptomatology scale). It was administered by one trained rater. All schizophrenics were scored on the PANSS after four weeks of neuroleptic treatment (Table I).

#### *A VISUAL ANALOGUE SCALE (David 1989)*

The subjects rated their mood at the time of testing on a decimetre scale ranging from "most depressed ever" on the extreme left end (scoring 0) to "most happy ever" on the right (scoring 100). The midpoint was not indicated on the scale.

#### *EMOTION LABELLING EXPERIMENT (Izard 1971)*

The experiment consist of a set of 36-photographs of human "emotional" faces (Fig. 1) standardised and cross-validated on nonpatients. These photographs were presented in slide form on a screen for approximately 10 s each, with an interval of 10 s between photographs. The projector located 6 feet from the subject.

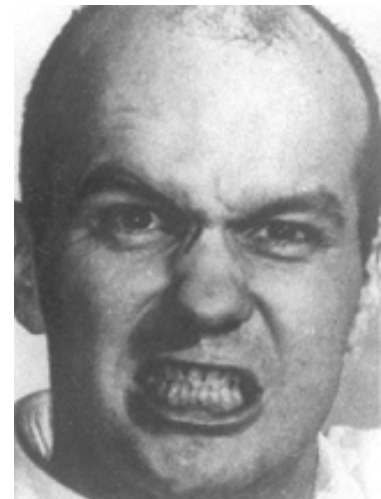
When each slide was projected on the screen the subjects were asked to look at it carefully and then describe how the person in the photo seems to be feeling. In some photos more than one emotion was apparent. However, subjects were told to decide which one emotion was expressed more strongly and most clearly and to write this down first on the answer sheet, then describe what other feelings, if any, appear to be expressed (Izard 1971).



Joy



Fear



Anger

Fig. 1. Examples of photos (Izard 1971).

*EMOTION RECOGNITION EXPERIMENT (Izard 1971)*

Before beginning the Emotion Recognition Experiment the subjects were provided with the list of nine fundamental emotions: interest-excitement, enjoyment-joy, surprise-startle, distress-anguish, disgust, contempt, anger-rage, shame-humiliation, fear-terror, and asked to study the names and definitions. Definitions of these emotions were presented in written form. In this experiment the same (as above) set of 36-photographs (included 4 photos for each of 9 emotion categories) was presented in the same way as before. After each slide the subjects were asked to select the one emotion from the list that best described the photo, then write the number of this photo in the appropriate space under the defined emotion category.

*BENTON FACIAL RECOGNITION TEST (Benton et al. 1983)*

This is a standardised objective procedure for assessment of the capacity to identify and discriminate photographs of unfamiliar, non-emotional human faces. The long form of the test consisting of 54 response items was used in this study.

The test is composed of three parts:

- matching of identical front – view photographs
- matching of front – view with three-quarter-view photographs,
- matching of front-view photographs under different lighting conditions.

Each trial was presented for as long as a subject needed to respond. One point was given for each correct match resulting in 54 possible points.

## RESULTS

### Demographic data

One way analysis of variance (ANOVA) indicated that the subject groups differed significantly in age (Table I). Post hoc analysis (Tukey test) showed that right brain-damaged patients were older than healthy controls ( $P<0.001$ ) and also older than chronic schizophrenics ( $P<0.001$ ). There was no significant age difference between chronic patients and normals ( $P=0.18$ ). In terms of years of education the groups were similar ( $P=0.09$ ). There were significant mood differences at the time of testing ( $P<0.05$ ). The Tukey test showed that Ns were

significantly happier than Rs and CSs ( $P<0.05$ ). Rs and CSs assessed their current mood similarly ( $P=0.24$ ). Mean values of the MMSE also differed significantly ( $P<0.001$ ). CSs and Rs revealed poorer cognitive ability than healthy volunteers ( $P<0.001$ ). The patient groups did not differ significantly in MMSE score (Table I).

For statistical analyses the scores on three facial tasks were converted to a ratio of correct answers.

### Benton Test

An analysis of variance (ANOVA) on the neutral facial perception data was conducted.

There was a main effect of group ( $F=26.47$ ,  $df=2$ ,  $P<0.001$ ). Post hoc Tukey analysis showed that the patient groups recognised neutral faces less accurately than the control group ( $P<0.001$ ), although there was no significant difference in test performance between Rs and CSs ( $P=0.36$ ) (Table I and Fig. 2).

Multiple regression analysis (mean Benton score as dependent variable) was carried out with age, sex, education, MMSE score, number of prior hospitalisations, psychiatric state, and duration of illness as covariate measure. From the wide spectrum of the examined variables there was a significant influence of only mean MMSE score on the performance on the Benton test ( $P<0.001$ ).

In the patient group, there was a positive Spearman correlation between the mean MMSE score and the Benton Facial Recognition Test score (Rs:  $r=0.56$ ,  $P<0.001$ ; CSs:  $r=0.39$ ,  $P<0.01$ ). There was also significant correlation between age and the face processing measure in Ns ( $r=0.38$ ;  $P<0.01$ ). However, years of education and current mood, severity of illness, neuroleptic dose, duration of illness and number of prior hospitalisations did not correlate significantly with mean BFRT score.

For both emotional experiments, analyses of covariance (ANCOVAs) were performed using the accuracy score on the Benton Facial Recognition Test as the covariate for each subject group.

When the effect of the Benton Facial Recognition Test was controlled, there was still a significant main effect of group for Emotion Labelling Experiment ( $F=19.05$ ,  $df=2$ ,  $P<0.001$ ). Again, when the effect of the Benton Facial Recognition Test was controlled *via* ANCOVA, the main effect of group was significant for Emotion Recognition Experiment ( $F=17.64$ ,  $df=2$ ,  $P<0.001$ ).



There was no statistically significant difference between females and males on the Benton test ( $t=1.2$ ,  $P=0.22$ ).

### Labelling and Recognition Experiments

ANOVA showed a significant main effect of group (CS, R, and N) for Labelling and Recognition task performance:  $F=69.7$ ,  $df=2$ ,  $P<0.001$  and  $F=69.4$ ,  $df=2$ ,  $P<0.001$ , respectively. Tukey analyses revealed a significantly greater impairment of Rs in their labelling of facial emotions than either the CSs ( $P<0.05$ ) or Ns ( $P<0.05$ ). Moreover, right brain-damaged patients performed less accurately on the Emotion Recognition Task relative to

the chronic schizophrenic patients and healthy volunteers (for both,  $P<0.05$ ) (Table III and Fig. 2).

To assess the effect of valence, emotion task items were grouped into two valence categories: positive (happiness, interest, surprise) and negative (sadness, disgust, anger, fear, contempt, and shame).

There was a significant group by valence (positive and negative) interaction for both the emotion labelling ( $F=8.14$ ,  $df=2$ ,  $P<0.001$ ) and recognition experiments ( $F=10.33$ ,  $df=2$ ,  $P<0.001$ ).

Finally, there was a main effect of valence for labelling ( $F=191.07$ ,  $df=1$ ,  $P<0.001$ ) and recognition ( $F=167.12$ ,  $df=1$ ,  $P<0.001$ ), with mean accuracy scores ordered as follows: positive and negative expressions.

Table III

ANOVA of face-processing measures for the 3 subject groups: chronic schizophrenics (CS), right brain-damaged patients (R), and normal controls (N)

	R	CS	N	<i>F</i>	<i>P</i>
<b>Total lab. exp.</b>	43.3 ± 15.9*~	52.5 ± 13.3*	74.9 ± 9.2	69.7	<0.001
Interest	38.3 ± 27.6*	32.0 ± 21.4*	64.5 ± 19.0	29.2	<0.001
Happiness	87.7 ± 22.8	91.5 ± 14.8	95.0 ± 10.1	2.1	0.1253
Surprise	60.8 ± 25.2*	69.0 ± 24.5*	89.5 ± 19.0	17.8	<0.001
Sadness	55.0 ± 28.9*~	72.0 ± 20.6*	85.0 ± 12.4	20.5	<0.001
Disgust	23.3 ± 32.1*	27.0 ± 29.8*	58.0 ± 27.9	18.5	<0.001
Contempt	10.0 ± 20.3*	19.5 ± 26.4*	44.5 ± 23.8	23.0	<0.001
Anger	59.2 ± 29.0*~	81.5 ± 21.9*	94.5 ± 11.6	27.3	<0.001
Shame	7.5 ± 16.3*	15.5 ± 22.5*	46.5 ± 25.8	35.9	<0.001
Fear	47.5 ± 23.1*	57.0 ± 32.4*	89.0 ± 16.9	32.0	<0.001
<b>Positive emotions</b>	62.2 ± 18.2*	64.1 ± 14.7*	83.1 ± 10.5	29.6	<0.001
<b>Negative emotions</b>	33.9 ± 18.2*~	45.5 ± 15.1*	69.7 ± 12.0	63.2	<0.001
<b>Total rec. exp.</b>	48.3 ± 15.0*~	57.5 ± 13.2*	79.1 ± 8.9	69.4	<0.001
Interest	45.8 ± 22.8*	41.5 ± 23.5*	70.5 ± 21.2	23.1	<0.001
Happiness	90.8 ± 16.7*	90.5 ± 15.9*	100.0 ± 0.0	8.4	<0.001
Surprise	63.3 ± 23.4*	68.0 ± 23.2*	87.5 ± 19.1	15.1	<0.001
Sadness	53.3 ± 19.4*~	72.5 ± 22.2*	89.0 ± 12.5	35.9	<0.001
Disgust	32.5 ± 30.9*	39.5 ± 24.8*	65.0 ± 27.7	16.8	<0.001
Contempt	21.7 ± 20.5*	32.5 ± 27.3*	51.5 ± 26.9	14.0	<0.001
Anger	58.3 ± 29.6*~	78.5 ± 23.7*	93.5 ± 12.2	24.6	<0.001
Shame	20.8 ± 17.5*	26.5 ± 17.8*	55.0 ± 24.7	34.4	<0.001
Fear	49.2 ± 16.7*~	63.0 ± 28.2*	91.5 ± 15.6	41.3	<0.001
<b>Positive emotions</b>	66.6 ± 17.0	66.7 ± 15.0*	86.1 ± 10.6	29.7	<0.001
<b>Negative emotions</b>	39.3 ± 17.0*~	52.1 ± 14.1*	74.3 ± 11.9	64.8	<0.001

\* ,  $P<0.05$  in post hoc Tukey test comparison between normals and patient groups; ~ ,  $P<0.05$  in post hoc Tukey test comparison between right brain-damaged patients (R) and chronic schizophrenics (CS).

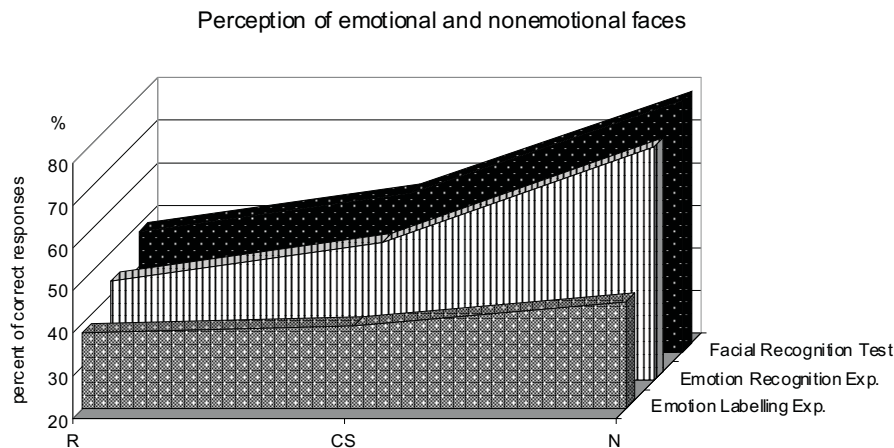


Fig. 2. Perception of emotional and non-emotional faces in each subject group. This figure illustrates the mean percent of correct responses obtained on facial perceptual measures (Emotion Labelling and Recognition Experiments, and Facial Recognition Test) in the chronic schizophrenics (CS), right brain-damaged patients (R) and normal controls (N).

ANOVA indicated that the subject groups differed significantly in labelling positive ( $F=29.6$ ,  $df=2$ ,  $P<0.001$ ) and negative affect ( $F=63.2$ ,  $df=2$ ,  $P<0.001$ ) and also in recognising positive ( $F=29.7$ ,  $df=2$ ,  $P<0.001$ ) and negative emotions ( $F=64.8$ ,  $df=2$ ,  $P<0.001$ ) (Table III).

Using a post hoc Tukey test to assess the group differences for each valence category, Rs were significantly more impaired than CSs in labelling of negative affect ( $P<0.05$ ) and also in the recognition of negative affect ( $P<0.05$ ). Furthermore, Rs and CSs labelled and recognised all valence categories of emotion less accurately than normals ( $P<0.05$ ) (Table III).

The mean ratings given to the four stimuli of each emotion category were calculated.

Tukey analyses showed that Rs were significantly more impaired than CSs for labelling sadness ( $P<0.05$ ) and anger ( $P<0.05$ ). Post hoc comparisons between the patients and normals revealed significant differences ( $P<0.05$ ) for labelling all the examined categories but happiness ( $P=0.12$ ).

Post hoc tests on the Emotion Recognition data yielded the same pattern of results as reported above. The patient groups, relative to Ns, obtained significantly lower scores in recognising all facial expressions. Furthermore, right brain-damaged patients compared to chronic schizophrenic patients were inferior in the recognition of sadness ( $P<0.05$ ), anger ( $P<0.05$ ), and fear ( $P<0.05$ ) (Table III).

There were no statistically significant differences between females and males in the labelling ( $t=1.4$ ,  $P=0.16$ ) and recognition experiments ( $t=1.1$ ,  $P=0.29$ ).

To assess the influence of the MMSE score, current mood and age on labelling and recognising of facial ex-

pressions, ANCOVA analyses were conducted with these variables as covariate measures.

There were no significant effects of mean MMSE score, current mood and age (assessed separately or together) on the judgement of facial expressions.

Moreover, significant Spearman correlations between mean scores of both emotion facial tasks and the Benton test in chronic schizophrenic group were found: labelling vs. Benton ( $r=0.46$ ,  $P<0.001$ ) and recognition vs. Benton ( $r=0.39$ ,  $P<0.01$ ). There was no significant correlation between PANSS score and Facial Emotion Tasks in the chronic schizophrenic group.

## DISCUSSION

Neuropsychological research on non-verbal behaviour leads to the conclusion that affect relies on specific neural pathways and more particularly, that the right hemisphere plays a dominant role in various emotional processes (Davidson 1984, Gainotti 1984). However, right hemisphere involvement in emotion processing might only be a particular instantiation of the holistic processes for which the right hemisphere is assumed to be specialised (Buck 1985).

The right brain - damaged patients and schizophrenic subjects revealed significantly greater impairment in the recognition of facial affect than healthy controls. Interestingly, the extent of these deficits among neurological subjects and chronic schizophrenics was comparable. Borod and Koff (1989) examined recognition of facial affect and vocal prosody and reported that schizophrenic patients performed poorly compared to normals but did not differ from patients with right hemisphere

damage. The similarity between the performance of the schizophrenics and right brain-damaged patients lends some support to the suggestion of right hemisphere dysfunction in chronic schizophrenia. Although the predominant view in the literature supports left hemisphere disorganisation in schizophrenia (suggested by flat affect, speech disorder and paranoia) some studies have found right hemisphere dysfunction (Borod and Koff 1989, Borod et al. 1993, Schweitzer 1982). According to Bowers et al. (1985) the salient role of the right hemisphere in emotion perception is that it contains schemata of prototypes for facial expressions or at least the hardware for activating these representations that would enable one to categorise facial expressions.

Another finding from this study is the lack of a significant correlation between performance on measures of emotion perception and the demographic and clinical variables, although there was a main effect of Benton test performance on facial emotion task performance in the chronic schizophrenic group. For the present study we did hypothesise that performance on measures of perception of facial emotion will be related to perception of faces *per se* and performance on tests of neurocognitive functioning. The schizophrenic patients might be expected to be emotionally and cognitively impaired (Kee et al. 1998, Basinska-Starzycka 2000) although to date, only a few studies have investigated the relationship between emotion perception and neurocognitive functioning in schizophrenia (Bryson et al. 1997, Lane et al. 1999, Schneider et al. 1992).

As far as the relationship between age and facial emotion task performance is considered, we did not find statistically significant correlations between mean age of subjects in each group examined and mean score on the facial emotion task. Different results were obtained by McDowell and co-workers (1994) in a healthy control group. Their findings suggested that the elderly were more impaired in processing negative affect compared to the younger group, while their ability to process positive affect was intact. This might support the hypothesis that the right hemisphere declines more rapidly than the left hemisphere in the ageing process (McDowell et al. 1994).

In our study positive and negative psychopathology as measured by the PANSS scale had no influence on the task performance in the schizophrenics. This is in accord with previous evidence of a lack of relationship between the perceptual emotion deficit and psychopathology (Novic et al. 1984, Lewis and Garver 1995, Bellack et al. 1996). Surprisingly, there was also no significant corre-

lation between mean MMSE score and mean scores on the facial emotion tasks. Current mood also did not alter the task performance among schizophrenics as previously reported (David and Cutting 1990). Moreover, a lack of significant correlation between emotion perception performance and neuroleptic dose in both our study and previous work may militate against neuroleptic effects being a crucial factor responsible for deficits in emotional performance (Schneider et al. 1992, Lewis and Garver 1995).

Data like our current results suggest a stable perceptual emotion deficit more than a state-dependent one. Furthermore, both patient groups showed significant difficulties compared to healthy controls in recognition of unfamiliar neutral faces, although this deficit was less than the deficit of facial affect perception. Moreover, there was a positive Spearman correlation between the mean scores of MMSE and Benton Facial Recognition Test in both patient groups. A significant correlation between age and the face processing measure was found in normal controls.

Bowers et al. (1985) showed that the impairments of facial affect recognition among right hemisphere-damaged patients remained even when their perceptual identity performance was statistically partialled out. This might suggest that the deficit in facial affect perception did not stem entirely from a visuo-perceptual impairment but also from different cognitive processes involved in matching views of unfamiliar faces (Bowers et al. 1985).

We found a significant relationship between the affected hemisphere and valence for emotional decoding. Right brain-damaged patients were significantly impaired compared to healthy volunteers in perceiving negative emotions only, whereas for perception of positive emotions, the group differences did not reach significance. These results lend some support to valence theory (Sackeim et al. 1982). Thus, one would predict that right brain damage leads to impaired perception of negative but not positive emotion. The predominance of right-sided activation in recent neuroimaging studies may also reflect the essential role of the right hemisphere in the perception of negative emotion *per se* (Phillips et al. 1998, Lane et al. 1999). Borod and co-workers (1993) found that schizophrenic patients, right brain-damaged patients and controls did not differ in the identification of positive emotions, but schizophrenics and right hemisphere-damaged patients were significantly impaired relative to controls in identifying negative emotions. The two patient groups did not differ



from each other. Interestingly, both patient groups were significantly impaired compared to healthy volunteers in recognising all expressions examined, although the valence expression comparison showed significantly greater impairment of the right brain-damaged group in perceiving negative affect. The groups did not differ on positive emotions. These results lend some support to the conclusion that affect relies on specific neural pathways and more particularly that the right hemisphere plays a dominant role in processing of emotions strongly connected with survival, preparation for action and vigilance-processes (Heilman 1982). This further supports the notion that right hemisphere functions may be affected in schizophrenia. In agreement with our data, schizophrenic patients have been found to recognise happiness most accurately and shame and disgust less well (Dougherty et al. 1974). Muzekari and Bates (1977) reported that chronic schizophrenic patients relative to healthy controls labelled negative emotions poorly but not positive ones. Mandal and Palchoudhury (1985) found significantly greater impairment in the recognition of fear and anger in chronic schizophrenics compared to normals.

These findings show much worse ability in schizophrenia for identification of negative affect. They might also suggest a differential deficit in emotional decoding (Bell et al. 1997). Such a deficit might stem from inefficient information processing following right hemispheric dysfunction.

In conclusion, chronic schizophrenics and right brain-damaged patients were significantly impaired compared to normal controls in perceiving facial affect but did not differ from each other, which might suggest a linkage between emotion perception in chronic schizophrenia and right hemisphere dysfunction. In our study perceptual deficit in schizophrenia was found to be stable. This may reflect a trait-like, rather than a state-dependent, characteristic.

While the data are suggestive, further investigations are needed to substantiate our conclusions and also to clarify the nature of generalised poor performance in emotional decoding in chronic schizophrenia and unilateral brain damage.

## CONCLUSION

Some support is provided for the notion that impaired perception of facial affect in chronic schizophrenia might be associated with right hemisphere dysfunction.

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