Emotion Recognition Deficit in Schizophrenia: Association with Symptomatology and Cognition

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Background: Previous investigations have found impaired recognition of facial affect in schizophrenia. Controversy exists as to whether this impairment represents a specific emotion recognition deficit when compared with other face recognition control tasks. Regardless of whether the emotion processing deficit is differential, it may uniquely influence other manifestations of schizophrenia. We compared patients and healthy control subjects on computerized tasks of emotion and age recognition. Performances on emotion and age recognition tasks were correlated with cognitive functioning and with symptomatology.

Methods: Thirty-five patients with schizophrenia and 45 healthy people underwent computerized testing for emotion and age recognition. Participants were assessed neuropsychologically, and patients were rated for positive and negative symptoms.

Results: The patients with schizophrenia performed worse than control subjects on emotion and age recognition without differential deficit. In both groups, we found higher error rates for identification of emotion in female faces and for identification of sad versus happy faces. In schizophrenic patients, emotion but not age recognition correlated with severity of negative and positive symptoms. In healthy control subjects, neither task correlated with cognitive functions. In schizophrenic patients, emotion but not age recognition correlated with attention, verbal and spatial memory, and language abilities.

Conclusions: This study did not reveal a specific deficit for emotion recognition in schizophrenia; however, our findings lend support to the concept that emotion recognition is uniquely associated with schizophrenia and in symptomatology and cognitive domains. Biol Psychiatry 2000;48:127–136 © 2000 Society of Biological Psychiatry

Key Words: Emotion recognition, schizophrenia, gender, cognition

Introduction

Processing of affect is an important component of social interaction (Anthony 1978; Charlesworth 1982; Izard 1971) and is supported by distributed neural systems (Damasio 1998; Heilman and Gilmore 1998; Lang et al 1998; Leventhal and Tomarken 1986; Mesulam 1998). Impaired processing of emotion has been noted in a range of disorders, including focal brain lesions (Adolphs et al 1994, 1996; Blonder et al 1991; Borod et al 1993; Bowers et al 1991; Sackeim et al 1982), Huntington’s Disease (Jacobs et al 1995), Parkinson’s Disease (Adolphs et al 1998), and neuropsychiatric disorders (Feinberg et al 1986; Gur et al 1992; Mikhailova et al 1996; Walker et al 1984). The study of emotion processing domains, including recognition, experience and expression, has benefitted from the use of standardized facial stimuli (Ekman et al 1972).

Abnormalities in emotional expression and experience have been reported since the earliest descriptions of schizophrenia (Bleuler 1911). More recently, deficits in facial-affect recognition also have been noted; however, an issue has been raised as to whether a differential deficit can be demonstrated against the more general impairment in facial processing (Kerr and Neale 1993; Salem et al 1996). Cutting (1981) reported that acutely ill schizophrenic patients performed poorly relative to patients in remission and patients with psychotic depression on an affect discrimination task, which compared “friendliness” and “mean-ness,” but not on color discrimination and age perception tasks. Walker et al (1984) studied patients with chronic schizophrenia, affective disorder, and healthy control subjects. Three emotional tasks of 16 faces each were used to probe emotion discrimination, emotion labeling, and multiple choice assignment of six different emotional valences (happiness, anger, fear, sadness, surprise, and shame) but not neutral faces. Although patients with schizophrenia performed as well as control subjects on the Benton Facial Recognition Test (Benton and Van Allen 1968), their performance on recognition of affect was significantly below the level of both control subjects and patients with affective disorders. Heimberg et al (1992) likewise re-
ported differential impairment in discrimination of happy and sad facial expression relative to age discrimination using a set of neutral, happy, and sad faces. Patients performed worse on emotion than on age recognition, whereas healthy subjects performed comparably on these tasks. Using the same testing paradigm (which included 254 faces, enabling comparison of happy versus neutral and sad versus neutral in a blocked design), Gur et al (1992) found that the deficit associated with schizophrenia was more marked compared with the performance of patients with depression. The large number of facial stimuli used, which permitted blocking sad and happy discrimination, enabled separate determination of false positive and negative rates for each emotion; however, the interspersed stimulus presentation of the other investigations is more naturalistic. Borod et al (1993) administered facial emotion identification and discrimination tasks of six different emotions and neutral, ranging from 21 to 32 facial stimuli to patients with schizophrenia, patients with right-brain damage, and healthy control subjects and found that both patient groups were impaired. When performances on the Benton Facial Recognition Test and a visuospatial task were used as covariates, this effect disappeared in both groups for the emotion discrimination, but not for the more difficult identification task.

In contrast, other studies indicate a generalized facial processing deficit in schizophrenia. Novic et al (1984) reported that patients performed more poorly than control subjects on a task requiring participants to match pictures with identical emotions, but when they controlled for performance on the Benton Facial Recognition Test, the difference became insignificant. The validity of the results is limited by the small number of presented stimuli (six out of 16) used in the analysis. Likewise, Feinberg et al (1986) found that schizophrenic patients were impaired on emotion matching and labeling tasks, but not on facial recognition tasks relative to depressed patients. Patients with schizophrenia were also impaired on emotion and facial recognition tasks compared with healthy control subjects. Archer et al (1992) reported that patients with schizophrenia were as impaired on facial expression recognition of six different emotions as they were on two facial recognition tasks, relative to patients with major depression and normal control subjects. For patient and control groups, performances on the tasks ranged between 89–98%, indicating that the experimental tasks may have been too easy to detect differences between the tasks. Schneider et al (1995) described similar results in that patients with schizophrenia were impaired relative to healthy control subjects on identification of happy, sad, and neutral expressions, as well as assessment of age; however, this study did not evaluate whether the deficit was generalized or specific. Kerr and Neale (1993) utilized a differential deficit design based on the requirements put forth by Chapman and Chapman (1978) as described below. This study compared a group of institutionalized and unmedicated with patients with chronic schizophrenia with a control group on tests of perception and discrimination of different emotions (happiness, sadness, fear, anger, shame, and surprise) and Benton’s Facial Recognition Test. Schizophrenic patients performed worse on all tasks without a differential deficit, indicating that they display impaired facial processing, rather than a specific emotion recognition deficit. Performance data were not presented. Using an abbreviated test design, Salem et al (1996) replicated these findings in a group of 23 medicated, male, chronic schizophrenia patients compared with a male control group. Although the differences in performance between patient and control groups reached significance, the magnitude of differences between tasks may not have been large enough to detect differential deficits for emotion recognition.

The lack of consensus on whether a generalized face processing deficit can account for the affect recognition deficit may have several reasons. Except for the last two studies mentioned, all investigators utilized different emotion recognition paradigms. The use of different facial control tasks may further have contributed to the disparity of findings; however, many studies utilized the Test of Facial Recognition as the control task. This test, in an original 54-face (Benton and Van Allen 1968) and shortened 27-face (Benton et al 1983) version, measures the ability to recognize faces without a memory component. Performance relies on visuospatial and linguistic processing and is impaired in patients with right parietal lesions, aphasia, and dementias (Lezak 1995). Most emotion recognition studies attempted to conform to the Chapman and Chapman (1978) differential deficit design. To establish differential deficit, the target and control tasks should be equated for difficulty and true score variance in healthy people; however, the methodologically important question of generalized face processing versus specific affect recognition deficit should be considered within the context of efforts to elucidate the pathophysiology of schizophrenia and treatment of its behavioral manifestations. Impaired emotion recognition has considerable impact on a person’s abilities to communicate and comprehend nonverbal cues. As such, impaired emotion recognition in the person with schizophrenia may exert adverse effects on psychosocial functioning independent of the presence and severity of positive and negative symptoms and cognitive difficulties. Although this issue was not explored in our present study, we believe emotion recognition is relevant for interpersonal and social adjustment and has impact regardless of its severity relative to cognitive deficits that serve as a control task.
Gender differences have been reported in the clinical presentation and course of schizophrenia. Men tend to have an earlier age of onset (Beratis et al 1994; Jayaswal et al 1987; Vazquez-Barquero et al 1995), poorer premorbid adjustment (Shtasel et al 1992), lower level of daily functioning, and worse negative symptomatology (Goldstein et al 1989; Salem and Kring 1998; Shtasel et al 1992) than women. No previous study has addressed the issue of gender differences in emotion perception in schizophrenia. In healthy subjects, women performed better than men (reviewed in Kring and Gordon 1998). Erwin et al (1992) reported an interaction of gender of poser with the gender of observer: women were more sensitive to male faces, whereas men showed a lack of sensitivity to sad expressions in women.

In our study, patients completed computerized emotion and age recognition tasks, along with ratings of symptomatology and neuropsychologic testing. The computerized tasks consisted of male and female faces with randomized neutral, sad, and happy affect. This was modified from our previous blocked stimulus design to allow for a more naturalistic methodology and better comparability with other studies. The control task used the same type of stimuli and differed only in the requirement to rate age rather than affect. The goals of the present study were to measure the severity of emotion recognition deficits in schizophrenia compared with age recognition performance. We also evaluated whether schizophrenic patients exhibit gender-related differences in emotion recognition similar to healthy subjects. Finally, we examined the association of emotion and age recognition performance with clinical and neurocognitive manifestations of schizophrenia.

We hypothesized the following: 1) Emotion and age recognition would be impaired in schizophrenia compared with healthy control subjects. 2) Male patients would exhibit a greater deficit than female patients. This finding would be consistent with worse symptomatology in men. 3) Impaired emotion, rather than age recognition, would be associated with severity of positive and negative symptoms. 4) Emotion recognition performance correlates with different cognitive functions than age discrimination performance. Support for hypotheses 3 and 4 would indicate that the emotion recognition deficit in schizophrenia relates uniquely to core features of the disorder.

**Methods and Materials**

**Subjects**

The sample consisted of 45 healthy people (25 men, 20 women) and 35 people with schizophrenia (20 men, 15 women). Recruitment of participants followed established procedures (Gur et al 1991; Shtasel et al 1991). Patients underwent diagnostic examination using the Structured Clinical Interview for DSM-IV (SCID-P; First et al 1995a) and met criteria for schizophrenia or schizophreniform disorder. Patients with the initial diagnosis of schizophreniform disorder (n = 7) were followed longitudinally and met criteria for schizophrenia. Patients with the diagnosis of schizoaffective disorder, any concomitant Axis I disorder, or history of any other disorder affecting brain function were excluded. Testing of age and emotion recognition and symptom and cognitive assessments were performed in patients who were symptomatic but clinically stable at the time of evaluation. At the time of emotion recognition testing, 31 patients were treated with standard neuroleptic medication, whereas four patients were medication naive (diagnosis schizophrenia:schizophreniform=3:1). Patients were treated with typical neuroleptics (n = 22), atypical neuroleptics (n = 4) or both (n = 5) at an average dose of 454 chlorpromazine equivalents per day. Medication exposure ranged from 1 week to 14.8 years. Healthy control subjects underwent comprehensive assessment including Structured Clinical Interview for DSM-IV nonpatient version (SCID-NP; First et al 1995b), physical examination, and laboratory tests to exclude concurrent psychiatric or other medical illness. Those with a family history of schizophrenia or affective illness were excluded. Sociodemographic data are presented in Table 1. Male and female control subjects did not differ in age, education, ethnicity, and handedness. Likewise, male and female patients did not differ in these variables. Clinically, they differed in age of onset of disease with men (20.6 years ± 4.7) having an earlier onset than women (25.3 years ± 7.9). They did not differ in number of hospitalizations. Patient and control groups differed in ethnicity, handedness, and education. As expected, patients attained fewer years of education than control subjects but did not differ in parental education.

**Procedures**

**EMOTION RECOGNITION TASK.** A computerized task, consisting of emotion and age identification subtests, was constructed using Authorware Professional 2.0 (Macromedia, San Francisco). The test is a computerized version of the emotion discrimination task developed in our laboratory (Erwin et al 1992). In the emotion discrimination condition, participants were presented with 40 faces displaying happy (five male, five female), sad (five male, six female), or neutral (nine male, 10 female) expressions (Figure 1). The emotion perception task included 40 faces of the same people with similar distribution of happy (eight male, six female), sad (five male, five female), or neutral (eight male, eight female) expressions. The order of stimuli was randomized but fixed across subjects.

Participants were asked to rate the emotional valence of the expression on each face on a seven-point scale ranging from very sad, moderately sad, somewhat sad, neutral, somewhat happy, moderately happy, to very happy. Choices were displayed on the screen along with the stimuli, and subjects responded by clicking the mouse button. As soon as participants had responded to all 40 emotion stimuli, the task proceeded to the age perception component. Subjects were asked to rate the age of the 40 facial stimuli on a seven-point scale ranging from “70s” on top to “teens” on the bottom. Average testing time for the entire task was 10 min for control subjects and 20 min for patients. Tests...
were administered by a trained neuropsychologic tester, and participants were provided with a demonstration of tasks and time to practice.

**SYMPTOM RATINGS.** Symptom severity ratings were performed by trained investigators (ICC > .85) and included the Scale for the Assessment of Negative Symptoms (SANS; Andreasen 1984a), the Scale for the Assessment of Positive Symptoms (SAPS; Andreasen 1984b), and the 21-item Hamilton Depression Rating Scale (HDRS; Hamilton 1960). Ratings were obtained within 3 months of testing in 27 of the 35 patients and within 8 months for the remaining patients. Patients remained clinically stable during this period.

**NEUROPSYCHOLOGIC BATTERY.** A standardized, previously detailed (Saykin et al 1991, 1994) neuropsychologic battery was administered to participants. Briefly, the battery consisted of tests evaluating eight functional domains:

2) Attention-vigilance: Continuous Performance Test (Gordon 1986), Seashore Rhythm Test (Halstead-Reitan Neuropsychological Test Battery HRB] Reitan and Wolfson 1985), letter and symbol cancellation (Mesulam 1985)
3) Verbal memory: story recall (Wechsler Memory Scale, Wechsler 1945; Wechsler Memory Scale-Revised, Wechsler 1987), California Verbal Learning Test (Delis et al 1983)
4) Spatial memory: design reproduction (Wechsler Memory Scale, Wechsler 1945; Wechsler Memory Scale-Revised, Wechsler 1987), Benton Facial Recognition (Benton and Van Allen 1968), Continuous Visual Memory Test Trahan and Larrabee 1988)
5) Verbal intelligence and language function: vocabulary (Wechsler Adult Intelligence Scale- Revised [WAIS-R], Wechsler 1981), controlled oral word association (Multilingual Aphasia Examination [MAE], Benton and Hamsher 1976), animal naming (Boston Diagnostic Aphasia Exam [BDAE], Goodglas and Kaplan 1983), MAE Visual Naming (Benton and Hamsher 1976), Reading Sentences and Paragraphs subtest from the BDAE (Goodglass and Kaplan 1983)
7) Sensory: stereognosis (Luria-Nebraska Neuropsychological Battery, Golden et al 1980)

The battery was administered by trained neuropsychologic technicians, who are supervised by neuropsychologists, and is scored according to the established procedures for each test. For 18 of the 35 patients and 23 of the 45 control subjects, the battery was administered within 3 months of the facial recognition tasks. For the remaining subjects, the battery was administered within a year.

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Table 1. Sociodemographic Characteristics

<table>
<thead>
<tr>
<th></th>
<th>Healthy group</th>
<th>Schizophrenic group</th>
<th>Significance</th>
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<tbody>
<tr>
<td>Gender (men/women)</td>
<td>25/20</td>
<td>20/15</td>
<td>ns</td>
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<tr>
<td>Age</td>
<td>27.5 ± 8.5</td>
<td>30.6 ± 9.5</td>
<td>ns</td>
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<tr>
<td>Handedness</td>
<td></td>
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<tr>
<td>Right: 42</td>
<td></td>
<td>Right: 26</td>
<td>χ² = 4.59</td>
</tr>
<tr>
<td>Left: 8</td>
<td></td>
<td></td>
<td>p = .03</td>
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<tr>
<td>Ethnicity</td>
<td></td>
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</tr>
<tr>
<td>White: 32</td>
<td></td>
<td>White: 16</td>
<td>χ² = 4.65</td>
</tr>
<tr>
<td>African American: 12</td>
<td></td>
<td>African American: 19</td>
<td>p = .02</td>
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<tr>
<td>Asian: 1</td>
<td></td>
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<tr>
<td>Subject education</td>
<td>14.9 ± 2.0</td>
<td>13.4 ± 2.4</td>
<td>t = 3.1</td>
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<tr>
<td>Parental education</td>
<td>11.7 ± 1.8</td>
<td>12.5 ± 2.5</td>
<td>p = .003</td>
</tr>
<tr>
<td>Age at onset</td>
<td></td>
<td></td>
<td>n.s.</td>
</tr>
<tr>
<td>men</td>
<td></td>
<td>20.6 ± 4.7</td>
<td>t = 2.1</td>
</tr>
<tr>
<td>women</td>
<td></td>
<td>25.3 ± 7.9</td>
<td>p = .05</td>
</tr>
<tr>
<td>Duration (years)</td>
<td></td>
<td>5.6 ± 7.8</td>
<td></td>
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<tr>
<td>No. of hospitalizations</td>
<td></td>
<td>1.45 ± .51</td>
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</tbody>
</table>

Figure 1. Neutral, sad, and happy facial expressions.
**Data Analysis**

**EMOTION AND AGE RECOGNITION.** The dependent measure for performance was error rate defined as percentage of responses that are more than one point away from the correct response on the seven-point scale. In the emotion discrimination task, the correct response was defined by the mean of the normative sample used to validate the stimuli (Erwin et al 1992). For the age discrimination task, birth dates were available for each poser. These percentages were determined separately for male and female faces. To satisfy normality assumptions for the repeated measures multivariate analysis of variance (MANOVA), these percentages were transformed using the arcsin transformation. The model used was a repeated measures MANOVA, with error rates (for emotion and age discrimination tasks) as outcome measures, diagnosis (patients, control subjects), and gender of the observer as between-group factors, and gender of facial stimuli as the within-group factor. Handedness, ethnicity, and education were considered as covariates in our model. Additionally, a model was fit to the patient group to assess the impact of duration.

**SYMPTOM RATINGS.** Spearman correlation coefficients were computed for emotion and age recognition errors (arcsine transformed for normality) and for cognitive domains of abstraction-flexibility, attention, verbal and spatial memory, language and spatial abilities, and motor and sensory abilities. For the neuropsychologic battery, raw test scores were transformed to standard equivalents (z scores) using the means and SEM of the normal control group, as previously described (Saykin et al 1991, 1994).

**Results**

**Emotion and Age Recognition**

The mean error rates for male and female faces in patients and controls (Figure 2) indicate impaired performance in schizophrenia that is moderated by gender of poser and gender of subject. The MANOVA comparing error rates in the age and emotion discrimination tasks showed that patients performed worse than comparison participants across tasks \( F(1,76) = 24.00, p < .001 \); however, there was no task \( \times \) diagnosis interaction \( F(1,76) = 1.30, p = .25 \). Thus, the hypothesis of differential deficit in emotion discrimination was not supported. Follow up ANOVAs for the age discrimination tasks revealed a main effect of diagnosis \( F(1,76) = 18.04, p = .001 \). For emotion discrimination, there were main effects of

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**Figure 2.** Means of error rates for the age discrimination and emotion discrimination tasks for male and female posers (facial stimuli) in men (CNT_M) and women (CNT_F) who are healthy and in men (SCH_M) and women (SCH_F) who are ill with schizophrenia.
both diagnosis \[F(1,76) = 10.95, p = .001\] and gender \[F(1,76) = 4.78, p = .03\], with women having fewer errors.

A MANOVA breaking the scores by poser’s gender showed a task × poser gender interaction, \[F(1,76) = 4.39, p < .05\], reflecting increased error rate for judging emotional displays of female posers in contrast to equal error rate on age discrimination. To test this hypothesis more directly, we calculated an opposite-gender emotion detection index, defined as same-gender errors minus opposite-gender errors. As predicted, this score was negative for men \[-0.04 ± 0.06, t(23) = 2.95, p < .01\] and positive for women \[0.05 ± 0.07, t(18) = 2.59, p < .01\] in the healthy group (between group difference was significant, \(t = 3.92, p < .001\)). The effect was absent in men with schizophrenia \[-0.02 ± 0.03, t(18) = 0.46, p = .65\] and not significant in women with schizophrenia \[0.04 ± 0.03, t(13) = 1.41, p = .18\] probably attributable to low power (because the effect size is similar to that of the healthy women).

The inclusion of handedness, education, and ethnicity as covariates did not alter our findings. Additionally, in a separate model including only patients, when duration was added as a covariate, none of these findings were altered.

A MANOVA contrasting emotion discrimination performance for happy with sad faces showed a main effect of emotional valence, with more errors for sad than happy faces \[F = 1.76, df = 1.76, p < .001\]. When performance was examined separately for happy and sad expressions, we found different effects for the two tasks depending on diagnosis and gender. Patients performed more poorly than control subjects on recognition of happy faces \[F = 8.16; df = 1.76; p = .005\], whereas the effect is weaker for sad faces \[F = 4.54; df = 1.76; p = .036\]. Men performed more poorly on identification of sad faces regardless of diagnosis \[F = 5.84; df = 1.76; p = .018\]. Whereas fewer errors were made across groups in identifying happy faces than identifying sad faces, men across groups identified sad female expressions most poorly \[F = 12.15; df = 1.76; p < .001\].

### Emotion and Age Recognition and Cognition

Results for subjects who completed emotions and neuropsychologic testing within 3 months and more than 3 months apart were similar and are reported for whole patient and control groups. In healthy control subjects, neither emotion nor age recognition performances showed significant correlations with any neuropsychologic domain (Figure 3). In patients, age recognition performance was not correlated with neurocognitive performance, but better emotion recognition performance was correlated specifically with better abstraction-flexibility \([r = .36, df = 33, p < .05]\), attention \([r = .60, df = 33, p < .001]\), verbal \([r = .59, df = 33, p < .001]\), and spatial memory \([r = .65, df = 33, p < .001]\), and language abilities \([r = .55, df = 33, p < .001]\).

### Discussion

Patients performed more poorly than control subjects on both facial processing tasks, without an indication of differential impairment. Chapman and Chapman (1978) proposed that to probe for the presence of a differential deficit, performance of an experimental task needs to be compared with performance on a psychometrically matched control task. Over the past 15 years, studies that have used a differential deficit design have yielded findings both supporting (Borod et al 1993; Heimberg et al 1992; Walker et al 1984) and failing to support (Archer et al 1992; Feinberg et al 1986; Kerr and Neale 1993; Novic et al 1984; Salem et al 1996) the presence of such a differential or specific emotion recognition impairment. We reported differential deficit in an earlier study (Heimberg et al 1992), which used a larger set of the same facial stimuli but presented them in a blocked rather than interspersed or randomized design as was done here. Whether blocked presentation makes the task more sensitive to differential impairment in schizophrenia merits further study.

Although impairment in age discrimination was similar in men and women with schizophrenia, men were disproportionately impaired in emotion recognition relative to women with schizophrenia. When we evaluated recogni-
tion of happy and sad faces, these effects too were moderated by the observers’ gender and diagnosis. All groups had fewer errors for happy than for sad discrimination, replicating our earlier reports (Erwin et al 1992; Heimberg et al 1992). Also replicating an earlier finding (Erwin et al 1992), women were more accurate in discriminating emotions on male than on female faces, whereas men did not show the corollary effect. This result could be interpreted to suggest that women are less facially expressive, but recent evidence indicates that women are more facially expressive in their emotions (Kring and Gordon 1998); however, this finding is consistent with the “hunter-gatherer” hypothesis (Cherney and Ryalls 1999; Hill 1984; Lee 1974). This hypothesis stipulates that from an evolutionary standpoint, it was much more important for individuals of both genders to interpret emotional displays of the physically powerful and socially dominant male than to detect emotional expression in females. It is noteworthy that both male and female patients made more errors than control subjects in recognizing happy expressions. For sad expressions, men but not women with schizophrenia showed impairment relative to control subjects.

Beyond the question of differential deficits, the aim of this study was to examine whether emotion processing deficits are uniquely associated with neurocognitive performance and symptom severity. The results supported this notion. Although neither symptom severity nor neuropsychologic performance was associated with age recognition errors, both were associated with errors in emotion discrimination. The correlations with symptoms were significant for the negative symptoms of alogia and for the positive symptoms of hallucinations and thought disorder. Positive symptoms (Barta et al 1990; Shenton et al 1992) have been linked to neural circuitry of the temporal lobes, whereas negative symptoms have been associated with frontal (Buchanan et al 1994) and to a lesser extent temporal (Turetsky et al 1995) structures. It was surprising to find that the emotion processing deficit was associated with alogia, rather than other negative symptoms such as affective flattening, avolition, or anhedonia. This suggests that emotion recognition has at least partially independent effects on symptomatology that do not necessarily relate to disturbed affect and psychosocial functioning. Furthermore, the association of emotion recognition, but not age recognition, with core symptoms of schizophrenia offers indirect evidence that emotion recognition may help examine temporolimbic features of schizophrenia. Longitudinal designs are needed to establish whether change in performance on emotion discrimination tasks is predictive of symptomatic improvement.

The were no correlations between performance on either age discrimination or emotion discrimination and neuropsychologic domains for the healthy participants. This is unusual because most cognitive tasks share common variance related to sensory input, attention to the task, facial processing, and linguistic ability (the “g factor”). Nonetheless, there is increased evidence that face processing has distinct neural substrates (see review in Mesulam.

Figure 3. Spearman correlation coefficients between age (shaded columns) and emotion (solid columns) recognition errors in schizophrenia subjects. SANS, Scale for the Assessment of Negative Symptoms; AFF, affect; ALO, alogia; AVO, avolition; ANH, anhedonia; SAPS, Scale for the Assessment of Positive Symptoms; HAL, hallucinations; DEL, delusions; BIZ, bizarre behavior; THD, thought disorder; NP, neuropsychological; ABF, abstraction–flexibility; ATT, attention; VMEM, verbal memory; SMEM, spatial memory; LAN, language; SPA, spatial; SEN, sensory; MOT, motor.
In patients, although there were no correlations between age discrimination and neuropsychologic performance, significant and large correlations were observed between performance on emotion discrimination and several neurocognitive domains. These were specific to abstraction and mental flexibility, attention, memory (verbal and spatial), and language, all related to frontal and temporal functioning. Several studies have indicated differential deficits in verbal memory in patients with schizophrenia, superimposed on generally lower cognitive performance (Saykin et al 1991, 1994). Thus, the correlations suggest that the impairment in frontotemporal functions extends to limbic regions related to emotional processing. Our study is limited in sample size and the cross-sectional design; it does not offer correlations between emotion processing and regional brain function. Based on our findings, however, we propose that emotion recognition, as a primarily temporal lobe function, is impaired in schizophrenia and contributes to the deficit load of patients suffering from this disorder. Even though the deficit is not more severe for emotion recognition than for age recognition, the emotion processing deficit is uniquely associated with symptom severity and neurocognitive deficits and therefore merits further scrutiny.

Our study has several limitations related to the task and patient sample. Compared with our previous study of emotion and age recognition in schizophrenia, the present study uses only 40 stimuli, which may yield insufficient statistical power to probe for differential impairment regarding positive and negative emotions. The age recognition task, although carefully constructed to serve as a control task that differs only in the component of recognition, may represent another limitation. Facial display of emotions may influence the assessment of age. Furthermore, the requirement to assess emotional faces for age rather than affect could be distracting to the subjects. The number of moderately emotional faces in the age recognition task was insufficient to probe for this effect. These test-related limitations may have contributed to the failure to establish a differential deficit for emotion recognition. On the other hand, the association of emotion recognition, but not age recognition, with severity of symptoms and to a lesser extent with cognitive impairment, can be considered as indirectly supporting the presence of specific associations for the emotion processing deficit. Limitations regarding the patient group included patients being at different stages of the illness, the use of different neuroleptics, and relating experimental measures that were not performed at the same time. Patients were tested at different times of illness, including seven patients with schizophreniform disorder who were later diagnosed with schizophrenia. Testing of age and emotion recognition and symptom and cognitive assessments were performed in patients who were symptomatic but clinically stable at the time of evaluation. Unfortunately, the sample of patients with first onset of schizophrenia was too small to allow for comparison with more chronically ill patients. The use of different medications, including atypical, typical, and combined typical and atypical neuroleptics, as well as the presence of neuroleptic-naive patients, precluded comparison of medication effects. It is noteworthy that comparing the patients who underwent symptom rating within 3 months of testing to those with larger intervals were remarkably similar. Nonetheless, it would have been preferable if all assessments had been be performed within shorter intervals.

Comparison of patients with schizophrenia with those who have depression or mania with psychotic features may help elucidate the disease specificity of deficits in emotion recognition. Comparison of schizophrenia with patients suffering from temporal lobe epilepsy would yield information regarding emotional processing associated with impairment in temporolimbic processing. To study the effects of medication and stage of illness, we need to assess emotion recognition longitudinally in the setting of standardized neuroleptic medication treatment. Evaluation of emotion recognition using functional imaging will help delineate the extent of neuronal impairment related to emotional processing that may contribute the pathophysiology of schizophrenia.

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