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# Facial emotion recognition impairment is related to disorganisation in multi-episode schizophrenia

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ABSTRACT

The present investigation explores the relationship between facial emotion recognition (FER) and symptom domains in three groups of schizophrenia spectrum patients (43 ultra-high-risk, 50 first episode and 44 multi-episode patients) in which the existence of FER impairment has already been demonstrated. Regression analysis showed that symptoms and FER impairment are related in multi-episode patients, regardless of the illness duration. We suggest that the link between symptoms and FER impairment is involved in the progression of the disease.


## 1. Introduction

In schizophrenia facial emotion recognition (FER) impairment is stable at different stages of the disorder (Comparelli et al., 2013), regardless of the improvement of symptoms over time (Kohler et al., 2000). FER impairment is associated with lower community functioning (Kee et al., 2003), decreased levels of role (Eack et al., 2010), social functioning (Addington et al., 2006), and diminished interpersonal skills (Pinkham and Penn, 2006). As of the relationship with symptoms, we found an association with disorganisation (Comparelli et al., 2014), although associations with positive and negative symptoms (Schneider et al., 1995) were reported as well. One limitation of the literature to date is that it has tended to involve assessments at one point in time, leaving unclear the role that the deficit and its relationship with other aspects of the disease play over time for persons in different phases of illness. Thus, unresolved at present is whether association with core aspects of the disorder such as negative and disorganization symptoms are stable in different phases of illness. Better understanding of this relationship may highlight the predictive role of specific factors on the progression of the illness.

## 2. Methods

### 2.1. Subjects

We here reanalysed data from a previous study (Comparelli et al., 2013) in which we found that FER impairment was present before the onset of the full-blown psychosis and was stable across the illness. We enrolled 137 male and female patients over the age of 18 years who were referred either to our Acute Psychiatric Care Department or to our outpatient clinic. Forty-three patients met criteria for psychosis risk syndrome (McGlashan et al., 2010). Ninety-four patients met a diagnosis of DSM-IV schizophrenia or schizophreniform disorder based on the Structured Interview for DSM-IV Disorders-I (SCID-I) (First et al., 1997). Within this group, 50 patients were experiencing their first psychotic episode with very recent onset. Forty-four had an established diagnosis of schizophrenia with multiple-episode history. Exclusion criteria and further details of the patient population have been provided elsewhere (Comparelli et al., 2013). All participants provided informed consent for participation in the study and publication of results. The research was approved by the hospital's Ethics Committee.

### 2.2. Psychopathological assessment

Prodromal patients were assessed through the Italian version of the Scale of Prodromal Symptoms (Comparelli et al., 2011a). Psychopathology was rated through the Positive and Negative Syndrome Scale (PANSS)

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(Kay et al., 1987). For statistical analysis we used the PANSS factor analysis according to Lykouras et al. (2000), who extracted the following five factors: a) Positive (P1 delusions, P3 hallucinatory behaviour, P5 grandiosity, P6 suspiciousness, and G9 unusual thought content); b) Negative (N1 blunted affect, N2 emotional withdrawal, N3 poor rapport, N4 passive withdrawal, N6 lack of spontaneity, G7 motor retardation, G16 active social avoidance); c) Excitement (P4 excitement, P7 hostility, G8 uncooperativeness, G14 poor impulse control); d) Anxiety and Depression (G2 anxiety, G3 guilt feelings, G4 tension, G6 depression); e) Disorganisation (N5 difficulty in abstract thinking, N7 stereotyped thinking, P2 conceptual disorganization, G11 poor attention).

The overall level of cognitive functionality was evaluated using the Raven Standard Progressive Matrices (RSPM) (Raven, 2008).

### 2.3. Facial emotion recognition assessment

To assess the facial emotion recognition ability, we used a specific FER test for face expression recognition (Comparelli et al., 2011b, 2012, 2013) based on Ekman and Friesen's (Ekman and Friesen, 1975) facial emotion theory of six basic emotions. The test is formed by two parts. In subtest A, each participant had to recognize a given emotion seven times; a face referring to a given emotion appeared seven times during the test in random order. Each correct guess was scored as 1, so that the participant may score 0 to 42 on the test and 0–7 on each emotion. In subtest B, four different facial expressions were shown on the monitor each time along with one emotion label; the participant was requested to indicate which face expresses the emotion displayed on the video. Eighteen four-face sets were provided, three sets for each emotion, and each correct guess was given a score of 1, for a possible range of 0–18. There was no time limit for completion. No feedback was provided about accuracy of performance. Both subtests measure emotional face recognition, but underlie different cognitive processing, as subtest A is an identification task (verbal modality), while subtest B is a recognition task (nonverbal modality). For more details regarding the test administration see Comparelli et al. (2013).

### 2.4. Statistical analysis

In our previous report (Comparelli et al., 2013), we analysed differences in socio-demographic, IQ, clinical features and FER performance among three clinical subgroups (UHR, FES, MES) and a healthy control group.

To determine associations between symptoms and FER identification and recognition scores, we performed partial correlations correcting for the possible confounding role of the variables that differed among groups. Then, we performed a stepwise regression analysis including all patients. We insert duration of illness and PANSS factors as independent variables and FER scores as dependent variable. Finally, a regression analysis with significant PANSS factor scores as independent variable and FER scores as dependent variable was carried out. A significance level of 0.05 was used for all statistical tests, and two-tailed tests were applied. Tests were carried out with the statistical package SPSS (version 17.0.2).

## 3. Results

Clinical groups differed for sex, age, duration of illness, IQ and the PANSS positive factor (Table 1). As mentioned in our previous report (Comparelli et al., 2013), the three clinical groups performed worse than healthy control subjects both on the identification and on the recognition tasks. ANCOVA analysis showed no differences between the number of correct answers on both the total scores of subtests A and B between FES and UHR. MES performed significantly worse than UHR on subtest A. Partial correlations (Table 2) adjusting for age, sex and IQ showed that in MES both the identification and the recognition scores correlated negatively with the PANSS positive, negative and disorganisation factor. Correlations retained statistical significance when the illness duration was taken into account. No other significant correlations between PANSS factors and the number of correct answers on the FER tasks were found in MES. In UHR and FES, no significant correlations were found. The stepwise analysis performed on the whole sample with PANSS factors and illness duration as independent variables and FER scores as dependent variables showed that the only unique factor that predicted FER impairment was disorganisation (Subtest A: $B = -.403$; Beta $= -,367$; $t = -4.225$; $p < 0.001$; Subtest B: $B = -.249$; Beta $= -.374$; $t = -4.326$; $p < 0.001$). When we carried out the regression excluding UHR and FES, PANSS disorganised factor severity explained 42.3% of the variance of the identification test score ($B = -.495$; Beta $= -.650$; $t = -5.544$; $p < 0.001$). No other variables entered into the model with statistical significance.

## 4. Discussion

The purpose of this re-analysis was to determine whether symptoms domains were related to emotion recognition in people affected by

**Table 1**
Socio-demographic and psychopathological characteristics of high-risk for psychosis, first-episode schizophrenia and multi-episode schizophrenia subjects.

| Male | Ultra high-risk (43) | | | First episode schizophrenia (50) | | | Multi-episode schizophrenia(44) | | | Analyses | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | N | % | | N | % | | N | % | | $\chi^2$ | df | P |
| | 12 | 27.9% | | 38 | 76% | | 29 | 65.9% | | 21.3 | 3 | <0.001* |
| | Mean | SD | 95% CI | Mean | SD | 95% CI | Mean | SD | 95% CI | F | df | P |
| Age | 23.2 | 3.6 | 21.9–24.5 | 25.0 | 7.1 | 23.2–26.8 | 34.3 | 7.9 | 31.9–36.7 | 32.6 | 2,134 | **<0.001**[a] |
| Duration of illness (yrs) | 0.2 | 0.4 | 0.0–0.45 | 0.4 | 0.5 | 0.3–0.5 | 9.5 | 6.1 | 7.7–11.4 | 107.6 | 2,134 | **<0.001**[a] |
| Years of education | 13.7 | 2.3 | 12.8–14.5 | 12.6 | 2.8 | 11.9–13.3 | 12.9 | 2.9 | 12.1–13.9 | 1.5 | 2,134 | 0.226 |
| IQ | 101.7 | 8.6 | 97.9–105.5 | 97.7 | 8.7 | 95.3–100.1 | 93.1 | 5.8 | 90.6–95.4 | 6.6 | 2,134 | **0.002**[b] |
| PANSS Pos | 11.7 | 3.8 | 10.3–13.1 | 18.3 | 6.1 | 16.8–19.8 | 14.9 | 5.7 | 13.2–16.6 | 15.6 | 2,134 | **<0.001**[c] |
| PANSS Neg | 21.6 | 6.6 | 19.1–24.0 | 23.0 | 8.6 | 20.9–25.1 | 25.6 | 6.8 | 23.6–27.7 | 2.9 | 2,134 | 0.062 |
| PANSS Exc | 8.4 | 2.9 | 7.3–9.5 | 11.4 | 5.3 | 10.1–12.7 | 11.2 | 5.1 | 9.6–12.7 | 4.4 | 2,134 | **0.014**[a] |
| PANSS Dep | 14.4 | 3.9 | 12.9–15.8 | 13.5 | 4.3 | 12.5–14.6 | 12.7 | 4.5 | 11.3–14.1 | 1.5 | 2,134 | 0.224 |
| PANSS Dis | 9.2 | 3.4 | 7.9–10.4 | 12.1 | 4.6 | 10.9–13.3 | 11.1 | 4.7 | 9.6–12.5 | 4.7 | 2,134 | **0.010**[d] |
| PANSS Tot | 81.0 | 14.8 | 75.6–86.4 | 95.1 | 18.5 | 90.5–99.7 | 93.3 | 18.0 | 87.8–98.8 | 7.1 | 2,134 | **0.001**[a] |
| Identification | 27.5 | 4.9 | 25.7–29.3 | 24.4 | 4.7 | 23.3–25.6 | 23.9 | 6.5 | 21.9–25.9 | 4.6 | 2,134 | **0.012**[a] |
| Recognition | 13.6 | 2.4 | 12.7–14.5 | 11.8 | 2.9 | 11.1–12.5 | 12.4 | 3.9 | 11.2–13.5 | 3.4 | 2,134 | **0.036**[d] |

Bold type represents statistical significance <0.05.
* UHR vs FES and MES.
[a] MES vs UHR and FES.
[b] UHR *vs* MES.
[c] UHR *vs* FES; FES *vs* MES.
[d] UHR *vs* FES.

**Table 2**
Partial correlation between PANSS factors and corrected answer on emotion recognition tasks in UHR, FES and MES *(first line UHR group; second line FES group, third line MES group)*.

| | PANSS POS | PANSS NEG | PANSS EXC | PANSS DEP | PANSS DIS |
|---|---|---|---|---|---|
| Identification | .373 | −.034 | .325 | −.085 | −.031 |
| | .074 | .199 | −.057 | .192 | .099 |
| | −.410 | −.347 | −.375 | .085 | −.833** |
| Recognition | .164 | −.215 | .039 | .055 | .116 |
| | .002 | −.024 | −.094 | .004 | −.296 |
| | −.543* | −.575* | −.122 | −.191 | −.571* |

*p < 0.05; **p < 0.001.
PANSS POS: positive factor. PANSS NEG: negative factor; PANSS EXC: excitement factor; PANSS DEP: depressive factor; PANSS DIS: disorganized factor.

schizophrenia at different stage of illness. Although there were significant association between positive, negative and disorganised symptoms, the last symptom domain consistently emerged as the only unique predictor of emotion recognition in people with multi-episode schizophrenia. The lack of association between symptoms, measured with PANSS, and FER performance in the UHR and first-episode groups has also been reported by Amminger et al. (2011). In contrast with our results, Leung et al. (2011) showed the absence of such a relationship even in multi-episode patients. Indeed, Leung et al. (2011) measured only positive and negative symptoms with SAPS and SANS (Andreasen, 1990), whereas our study utilized symptom domains extracted by the PANSS principal component analysis.

Another recent study that explored the relationship between FER performance and PANSS traits found a relationship between disorganised symptoms and FER (Hamm et al., 2012) in a sample of schizophrenia patients with a duration of illness and mean number of episodes comparable to that of our patients. Thus, inconsistencies of results may be due to the use of different symptoms rating scales.

Considering the factor disorganization of the PANSS, the items loading on this factor are the same as those reported by other factorial analyses of the PANSS (Emsley et al., 2003; Lindenmayer et al., 1994; Rodriguez-Jimenez et al., 2013). They are all placed on different subscales in the original formulation of the PANSS and comprise one positive (conceptual disorganization), two negative (difficulty in abstract thinking and stereotyped thinking), and one general (poor attention) symptoms. Curiously, despite the growing evidence that cognitive symptoms and disorganisation form the psychopathological core of the illness, specific instruments for this symptoms domain are not available. Rediscovering Bleuler (Bleuler, 1950), the association between disorganisation and facial emotion recognition may constitute the psychopathological core of the illness. According to Bleuler there are two types of symptoms: fundamental and accessory. Fundamental symptoms are essentially disorganised in nature. They were separated into simple fundamental symptoms, including problems in association, affectivity, and ambivalence. These simple fundamental symptoms combined to form compound fundamental symptoms, including disturbances in attention. Attention for Bleuler was rather all encompassing. It included some features that we would call vigilance, but also expanded into areas that we might call social withdrawal. Thus, the disorganisation factor actually resembles fundamental symptoms. The fact that in our study the disorganisation domain and facial emotion recognition impairment are associated only in multi-episode is also consistent with Bleuler's theory that stated that fundamental symptoms are certainly present in advanced phases of the illness and constitute the hallmark of schizophrenia.

Although the correlative nature of our analyses precludes drawing causal conclusions, our findings suggest some implications for theoretical models of this relationship. Both disorganised symptoms and emotion processing deficits are, in fact, related to worse functional and biological outcomes (Collin et al., 2012; Lysaker et al., 1995). Our results suggest that the linkage between disorganisation and emotional dysfunction may influence or be influenced by the progression of the illness. In the former hypothesis their interaction may play a pathogenetic role, in the latter their relationship could be the final step of unknown mechanisms.

Given the prominence of social impairments in chronic schizophrenia, our research direction can help to identify underlying mechanisms that give rise to social outcome. Unresolved at present is whether formal thought disorders, difficulties in abstract thinking and social cognition represent different aspects of the "deficit schizophrenia" (Galderisi and Maj, 2009). In this view, one possibility that should be investigated in future studies is that disorganisation and facial emotion recognition reflect a shared aetiopathology with a possible genetic basis (Fett and Maat, 2011). Rival hypotheses cannot be ruled out, including the possibility of a complex mind/environment interaction in which early social cognition dysfunction, interacting with the external factors, paves the way for a deterioration and a stronger correlation with symptoms (MacBeth et al., 2013). In addition, our findings may have several clinical implications, since examination of underlying commonalities in emotional and thought/cognitive processes could inform treatments jointly aimed at emotional factors and cognitive deficits.

One limitation of our study is that its cross-sectional design does not allow definition of the role of the association between FER impairment and disorganisation in progression of disease. Moreover, we did not rule out a possible role of antipsychotic drugs in emotion recognition. The major strength of our study is that, to our knowledge, it is the first to compare the relationship between emotion processing deficit and symptoms in different groups of schizophrenia patients. As emotion recognition is a fundamental part of social cognition, this study is a step towards better understanding of the link between symptoms and social outcome.

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No funding source to declare.

## Contributors

Anna Comparelli designed the study, wrote the protocol, and revised the final draft of the manuscript. Antonella De Carolis undertook the statistical analysis. Valentina Corigliano wrote the first draft of the manuscript. Giada Trovini, Simone Di Pietro and Julia Dehning managed the literature searches and analyses. Eleonora De Pisa, Silvana Galderisi and Paolo Girardi approved the final manuscript.

## Conflict of interest

Paolo Girardi has received, in the past, research support from Lilly and Janssen and honoraria from Lilly and Organon and has also participated in Advisory Boards for Lilly, Organon, Pfizer, and Schering.

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