Brief report

Configural face processing in schizophrenia

Nicole Joshua a,b,⁎, Susan Rossell a,b,c,1

a Mental Health Research Institute of Victoria, Level 2, 161 Barry Street, Carlton South Victoria 3053, Australia
b The University of Melbourne, Parkville Victoria 3010, Australia
c Monash-Alfred Psychiatry Research Centre, Monash University School of Psychology, Psychiatry and Psychological Medicine, The Alfred Hospital, Victoria, 3004, Australia

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ABSTRACT

Evidence suggests schizophrenia patients may have problems integrating visual features into perceptual wholes using configural information. This deficit may impact on higher order socio-cognitive abilities such as facial emotion perception. Twenty-six schizophrenia patients and 26 age and gender matched healthy control participants completed a Fractured Faces Task which disrupted configural face information yet maintained featural information. While participants were matched for performance when viewing whole, unaltered faces; schizophrenia patients were significantly less affected than control participants when the configural information was disrupted. The results indicate altered configural processing and potential over-reliance on featural processing in schizophrenia. The implications of such impaired processing strategies are discussed.

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1. Introduction

1.1. Background

Social cognitive deficits are core features of schizophrenia, and are associated with poor functional outcome (Kee et al., 2003), poor interpersonal problem solving (Corrigan and Toomey, 1995), poor social competence, deteriorating illness course (Mueser et al., 1996), and increased rates of relapse and unemployment. Social cognitive deficits are apparent prior to illness onset (Baum and Walker, 1995), and observable in first-degree relatives of schizophrenia patients (Kee et al., 2004). Deficient facial emotion processing is one aspect of social cognition commonly reported in schizophrenia (Mandal et al., 1998). Patients show impaired matching, discrimination and recognition of facial emotional content (Borod et al., 1993; Morrison et al., 1988). A growing literature has begun to investigate the aberrant mechanisms behind such face processing problems.

Healthy perception of facial information involves several distinct processing styles. First, featural processing involves encoding the specific elements of the face (for example eyes, nose, and mouth). While this information is clearly crucial to recognition, featural processing alone cannot account for our wide range of face processing skills. We are able to recognise hundreds of different faces and their expressions despite changes in age, hairstyle, and facial hair as well as under short or poor viewing conditions. This has led researchers to investigate additional processing styles utilised to a greater extent in face recognition, namely configural processing. Configural processing involves encoding the relationships between facial elements. This involves two aspects; 1. First-order information (common to all faces), this refers to the basic organisation of elements i.e. the eyes belong above the nose and mouth, and 2. Second-order configural information, this refers to the specific spacing and distances between facial elements. The importance of second-order configural information for face perception is highlighted by the ‘face
inversion effect’ which reveals that face recognition is disproportionately impaired when stimuli are inverted compared to other types of visual stimuli (Yin, 1969). This occurs because configural information is lost or disrupted upon inversion and recognition must rely on featural processing alone. Thus, it is commonly agreed that both featural and configural (first and second-order) processing styles are required for accurate upright face perception.

While there are many studies which have employed facial stimuli to investigate social cognition in schizophrenia, the few studies that have specifically researched configural face processing have provided conflicting results. Schwartz et al. (2002) investigated configural processing in schizophrenia via the face inversion effect. The results indicated that schizophrenia patients were just as impaired on inverted faces as were healthy control participants. The researchers consequently concluded that schizophrenia patients do rely on configural information for face recognition. Similar results were obtained by Chambon et al. (2006) who revealed schizophrenia patients did show inversion effects for recognition of emotionally balanced faces. The findings did however indicate that patients with more severe symptoms showed a weaker inversion effect. Interestingly, the most recent published investigation into configural processing in schizophrenia contradicted these findings (Shin et al., 2007). Shin et al. investigated the face inversion effect using two sets of stimuli involving both featural and configural face manipulations. They found that the schizophrenia patients showed poorer performance for the configurally manipulated faces than those that had been featurally manipulated. They additionally demonstrated that patients did not reveal the typical face inversion effect, thus concluding that schizophrenia patients exhibit impaired configural face processing.

The current study aimed to clarify these discrepant results via a novel paradigm developed to investigate second-order configural face processing. For this study we selected a different method of configural disruption utilised in the Fractured Faces Task described below.

1.2. Predictions

It was hypothesised that schizophrenia patients would demonstrate disturbed face perception compared to controls. Specifically, it was predicted that the Fractured Faces Task would reveal a reliance on featural processing in schizophrenia. Configural disruption was thus expected to impact healthy control participants more adversely than schizophrenia patients as they rely on different strategies for face perception.

2. Method

2.1. Participants

Twenty-six patients with schizophrenia were recruited via community support groups and community care units. All schizophrenia participants were out-patients at the time of testing. Diagnosis was ascertained using the Structured Clinical Interview for DSM-IV (First et al., 1996). Current symptomology was acquired using the Positive and Negative Syndrome Scale (Kay et al., 1987). Global Assessment of Functioning (American Psychiatric Association, 2000) was also ascertained. Only patients with no other co-morbid Axis 1 diagnoses were included in the study. Clinical characteristics are presented in Table 1.

Twenty-six healthy control participants were recruited via newspaper advertisements. Control participants were not included if they had a history of psychiatric disorder or a first-degree relative diagnosed with schizophrenia. All participants met the following exclusion criteria: a) no history of neurological disorder or head trauma, b) no current substance abuse, c) no history of ECT in the last year, d) English as first language, e) between the ages of 18 and 65 years and f) predicted IQ >80 as scored by the National Adult Reading Test (Nelson and Willison, 1991). As shown in Table 1, there were no significant group differences in age or gender; and the control participants had significantly more years of education and higher predicted IQ.

![Example of famous face in fractured form condition (left) and whole form condition (right).](Image)

**Table 1**

Demographic information of the two participant groups (mean(S.D.)).

<table>
<thead>
<tr>
<th></th>
<th>Controls n = 26</th>
<th>Schizophrenia n = 26</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>43.15 (10.94)</td>
<td>38.69 (9.99)</td>
</tr>
<tr>
<td>Gender</td>
<td>12M, 14F</td>
<td>19M, 7F</td>
</tr>
<tr>
<td>Years of education</td>
<td>16.87 (2.63)</td>
<td>14.85 (2.80)</td>
</tr>
<tr>
<td>NART IQ</td>
<td>114.50 (7.27)</td>
<td>106.54 (11.45)</td>
</tr>
<tr>
<td>Age at illness onset</td>
<td>23.12 (6.61)</td>
<td>15.80 (9.01)</td>
</tr>
<tr>
<td>Illness duration</td>
<td></td>
<td>450.01 (256.89)</td>
</tr>
<tr>
<td>Medication – chlorpromazine equivalent</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Global Assessment of Functioning Score</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PANSS positive factor</td>
<td>53.46 (13.72)</td>
<td>12.77 (4.70)</td>
</tr>
<tr>
<td>PANSS negative factor</td>
<td>50.42 (14.05)</td>
<td>12.81 (6.14)</td>
</tr>
<tr>
<td>PANSS general factor</td>
<td>25.23 (6.76)</td>
<td>2.05 (2.68)</td>
</tr>
<tr>
<td>PANSS total factor</td>
<td>12.81 (6.14)</td>
<td>50.42 (14.05)</td>
</tr>
</tbody>
</table>

* Independent samples t-test.

* Chi-square.
2.2. Apparatus and stimuli

The stimuli and task design were based on that of Moscovitch et al. (1997). The experimental stimuli were 67 photographs of different famous faces. Each face was presented ‘fractured’ and ‘whole’. In the fractured condition, faces had been digitally cut into 5–6 segments. The segments were then spread apart. This ‘fracturing’ maintained featural information as the elements of the face remained intact. The first-order configurational information was also maintained as the general organisation of facial elements was preserved (i.e. eyes above nose above mouth). The ‘fracturing’ did, however, disrupt the second-order configurational information as the specific spacing and distances between facial elements was altered. An example face is presented in Fig. 1. An extensive item analysis was performed on the images based on the results from control participants. Three faces that were not recognised by at least 50% of the sample were excluded. Consequently, the final experimental set included 64 faces. All images were presented on a laptop computer with a standard 15.4-inch screen.

2.3. Design and procedure

The following design and procedure were approved by the Health Sciences Human Ethics Sub-Committee of The University of Melbourne. The Fractured Faces Task was completed as part of a larger cognitive battery that included a range of neurocognitive, emotion processing and other configural processing tasks that are not reported here. Participants were initially required to simply identify a series of the fractured famous faces described above. They were then shown the faces in their whole form and were asked to identify the face again. Participants were given one minute to verbally give their answer, receiving one point for each correctly identified face. Thus, participants received scores for the fractured and whole conditions, each out of a total of 64.

3. Results

Pearson’s Product Moment Correlations were performed with the task variables (fractured score and whole score) and the two demographic variables of difference (years of education and predicted IQ). No significant correlations were observed between fractured score and years of education ($r = -0.03$, $p > .05$) or predicted IQ ($r = -0.19, p > .05$) or between unfractured score and years education ($r = 0.05, p > .05$) or predicted IQ ($r = -0.10, p > .05$); thus, these demographic variables were predicted not to mediate task performance.

An important point worthy of highlighting was that the two participant groups were matched for familiarity with famous faces. This was confirmed via one-way analysis of variance (ANOVA) indicating no significant group difference in performance for the whole face condition ($F(1,50) = 2.84, p = .10$), the two groups were equally familiar with the identity of famous faces.

Repeated measures ANOVA examined task performance differences for the fractured and whole conditions between the two groups. The means and standard deviations are shown in Table 2. There was a significant condition effect ($F(1,50) = 271.10, p < .001$), indicating that all participants identified more famous faces when presented whole (48.4) than fractured (35.8). There was no main effect of group ($F(1,50) = 1.36, p = .25$), revealing healthy controls (43.8) and schizophrenia patients (40.3) did not significantly differ in their overall identification of famous faces over both conditions. The most pertinent finding of this analysis was a significant interaction between task condition and group ($F(1,50) = 4.47, p < .05$). The pattern of performance on the two conditions was different for the two groups. It appears configural disruption had significantly less of an impact on schizophrenia patients than healthy controls. Schizophrenia patients showed a smaller difference in performance between the fractured and unfractured conditions (10.96) than control participants (14.19). Performance difference between the two conditions for schizophrenia patients was not significantly correlated with any of the PANSS symptom variables.

4. Discussion

Schizophrenia patients appear to utilise different face processing styles compared to control participants. Controls rely more on second-order configurational information during face recognition, and were thus disadvantaged when this information was disrupted. These findings are in line with research into healthy face processing employing other forms of configural disruption such as inversion (Yin, 1969) and photo editing (Freire et al., 2000). Conversely, schizophrenia patients did not appear to utilise configural information to the same degree as the healthy controls, and seemingly relied more on featural information for face recognition. Accordingly, schizophrenia patients were less affected when second-order disruption occurred. Considering there was no overall group effect, the pattern of results do not appear indicative of a generalised cognitive deficit and are task or condition specific. This is a particularly unusual and interesting finding worthy of replication. Schizophrenia research typically indicates patients show an increased performance deficit as task demand increases. This study contrastingly, actually indicated a decreased performance deficit as task demand increased for schizophrenia patients. The difference in face processing style resulted in altered performance for schizophrenia patients on the Fractured Faces Task, however, under normal viewing conditions an excessive reliance on featural information and not enough on second-order configural information may impede perception when performing certain tasks.

There is considerable evidence from the perceptual organisation literature to support the notion that schizophrenic patients rely on fragmented, ‘bottom-up’ styles for visual processing (Uhlhaas and Mishara, 2007). Early pivotal work by John and Hemsley (1992) suggested schizophrenia patients fail to utilise ‘top-down’ processing styles during perceptual organisation and rely on more time consuming, bottom-up or ‘local’ approaches for perception. These findings, in the current context, would suggest that during face processing,

<table>
<thead>
<tr>
<th>Table 2</th>
<th>Means and standard deviations of fractured condition score and whole condition score for schizophrenia patients and control participants (mean(SE)).</th>
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<tbody>
<tr>
<td>Controls $n = 26$</td>
<td>Fractured Whole</td>
</tr>
<tr>
<td>Schizophrenia $n = 26$</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fractured</td>
</tr>
<tr>
<td>Fractured</td>
<td>36.73 (2.23)</td>
</tr>
<tr>
<td>Whole</td>
<td>50.92 (2.15)</td>
</tr>
</tbody>
</table>
schizophrenia patients rely more on featural processing than do healthy controls.

An over-reliance on featural information and impaired configural processing in schizophrenia confirms the results of Shin et al. (2007). Thus altered configural processing in schizophrenia can be observed under different conditions, that is fractured, spatially manipulated faces as well as inverted faces. The results are not in line with those of Schwartz et al. (2002) or Chambon et al. (2006) who found configural disruption via face inversion did not impact schizophrenia patients differently to controls. The discrepant findings may be attributable to the methodological, clinical or demographic differences between the studies. Firstly, the task used in the current study and the facial manipulation used by Shin et al. were designed to disrupt the second-order configural information only while maintaining the first-order information. The inversion techniques used by the other researchers only altered the first-order information. Therefore, it is possible schizophrenia patients rely only on first-order and featural information for face recognition; thus showing impaired performance like controls when the first-order information is disrupted yet different performances when the second-order information is disrupted. The task employed in Schwartz et al. (2002) also relied on memory abilities to a greater extent than Shin et al. and the current work. Memory impairments are consistently evident in schizophrenia (Stip, 1996).

The current schizophrenia sample consisted of chronic outpatients who on average had been diagnosed with schizophrenia for over 15 years. Differences in configural processing may occur over the course of the disorder, thus replications in other samples such as first-episode patients is warranted. This will clarify whether configural processing deficits may be primary or secondary to a diagnosis of schizophrenia. Additionally, the current sample had no other Axis I diagnosis which limits the generalisability of results to other psychosis patients which often meet other diagnostic criteria (for example anxiety, depression). Finally, the current schizophrenia sample was also underrepresented by males compared to females. Female and male schizophrenia patients can show differences in illness course, treatment criteria (for example anxiety, depression). Finally, the current schizophrenia sample was also overrepresented by males (Kee, 2003;Ke, 2004). The difference between men and women in schizophrenia is crucial. As the distances between facial elements change, patients can show differences in illness course, treatment compared to females. Female and male schizophrenia sample was also overrepresented by males (Kee, 2003;Ke, 2004).

During day-to-day viewing of faces, configural processing is crucial. As the distances between facial elements change, information is revealed regarding expression. For example we may speculate that subtle changes in the distance between the eyes, nose and mouth can indicate drastically different emotions i.e. frown, shock, disgust. Stephan et al. (2006) explored the relationship between featural processing, configural processing and emotion perception in prosopagnosia; and confirmed that configural face processing plays an important role in facial emotion perception. Thus, impairment in configural processing has the potential to impair many different social cognitive abilities involving facial information. While clearly not as dramatic as prosopagnosia, the impairment in schizophrenia may involve similar underlying mechanisms, thus, investigations of the correlation between configural face processing and emotion processing in schizophrenia are in preparation by the current authors.

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Contributors

Author Nicole Joshua managed literature searches, designed the study, wrote the protocol, collected the data, undertook the statistical analysis and wrote the first draft of the manuscript. Author Susan Rossell managed the study design, data collection and data analysis and edited the first draft of the manuscript. Both authors contributed to and have approved the final manuscript.

Conflict of interest

The authors declare they have no conflicts of interest.

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References


