Association Between Reduced Extraversion and Right Posterior Fusiform Gyrus Gray Matter Reduction in Chronic Schizophrenia

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Objective: The authors examined the association between volume of the fusiform gyrus, a region involved in face processing, and the personality trait of extraversion in patients with schizophrenia.

Method: Male patients (N=24) and age-matched male comparison subjects (N=26) completed NEO Five-Factor Inventory personality measures of extraversion and underwent high-spatial-resolution magnetic resonance imaging of anterior and posterior fusiform gyrus gray matter.

Results: Low extraversion scores were significantly correlated with gray matter volume reductions in the right posterior fusiform gyrus for patients but not comparison subjects.

Conclusions: Reduced right posterior fusiform gyrus volume may contribute to disease-related social disturbances, characterized by both low extraversion and reduced sensitivity to human faces.

Patients with schizophrenia often fail to recognize previously seen faces, and these difficulties may represent a specific deficit independent of the well-known disease-related generalized impairment of memory and visual attention (1). Face perception is mediated by a well-demarcated, distributed hierarchical neural system, the core of which consists of bilateral occipitotemporal regions in the extrastriate visual cortex, most notably the fusiform gyrus (2). Postmortem (3) and manual region of interest studies in patients with chronic (4) and first-episode (5) schizophrenia have all demonstrated fusiform gyrus abnormalities in schizophrenia patients. These in turn have correlated with lower scores on a neuropsychological test of delayed facial recognition memory in a sample of chronic patients (4).

The highly evolved face recognition ability of humans represents an important component of species social communication, naturally selected to solve adaptive problems critical for survival, such as distinguishing friend from foe, familiar from unfamiliar, related from unrelated. Schizophrenia is invariably accompanied by disturbances in social communication that may even predate disease onset (6). Unaffected biological relatives of patients also show reduced facial recognition memory, which is correlated with schizotypal personality traits (1). In a group of patients with chronic schizophrenia, we therefore explored the relationship between magnetic resonance imaging (MRI) volumes of the fusiform gyrus and sociality, as measured by the highly hereditable personality trait of extraversion (7).

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FIGURE 1. Delineation of the Anterior and Posterior Fusiform Gyrus Regions of Interest

TABLE 1. Correlations Between Relative Fusiform Gyrus Volume and NEO Extraversion Score in Male Patients With Chronic Schizophrenia and Matched Healthy Comparison Subjects

<table>
<thead>
<tr>
<th>Brain Area</th>
<th>Patients With Schizophrenia (N=24)</th>
<th>Healthy Comparison Subjects (N=26)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>r_s</td>
<td>p</td>
</tr>
<tr>
<td>Anterior fusiform gyrus</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Left</td>
<td>–0.015</td>
<td>0.94</td>
</tr>
<tr>
<td>Right</td>
<td>–0.028</td>
<td>0.90</td>
</tr>
<tr>
<td>Posterior fusiform gyrus</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Left</td>
<td>0.080</td>
<td>0.71</td>
</tr>
<tr>
<td>Right</td>
<td>0.524</td>
<td>0.01</td>
</tr>
</tbody>
</table>

of interest and T scores for extraversion, Spearman’s correlation was used to diminish the effect of any outliers. In this analysis we used p≤0.0125 as the cutoff value for statistical significance for fusiform gyrus subregions (four regions) and extraversion scores. In addition, simple linear regression analysis was performed to predict T scores for extraversion with fusiform gyrus gray matter relative volumes as independent values for each group.

Results

Overall NEO scores revealed significant group (F=7.93, df=5, 44, p<0.001) and group-by-scale effects (F=9.29, df=4, 45, p<0.001). In relation to the comparison group the patients showed a distinct NEO profile of increased neuroticism (F=38.59, df=1, 48, p<0.001) but reduced extraversion (F=9.36, df=1, 48, p=0.004) and conscientiousness (F=18.76, df=1, 48, p<0.001). ANOVA of standardized region of interest values (z scores) revealed a significant main effect of group (F=6.96, df=1, 48, p=0.01). For the fusiform gyrus, schizophrenia patients had bilateral reductions in anterior and posterior fusiform gyrus gray matter volumes relative to comparison subjects (left anterior: mean=2.54 [SD=0.44] versus 3.04 [SD=0.59], respectively; left posterior: mean=3.15 [SD=0.66] versus 3.66 [SD=0.81]; right anterior: mean=2.56 [SD=0.51] versus 2.93 [SD=0.54]; right posterior: mean=3.40 [SD=0.91] versus 3.77 [SD=0.74]).
Table 1 shows Spearman's rho correlations between relative fusiform gyrus volumes and T scores for extraversion in both groups. For patients but not comparison subjects, right posterior fusiform gyrus gray matter volume correlated significantly with extraversion score (rho=0.57, p=0.004 [absolute]; rho=0.52, p=0.009 [relative]). Fisher's z transformation revealed a significant effect for the right posterior fusiform gyrus/extraversion correlation for the patient group (z=–2.23, p=0.01 [absolute]; z=–2.27, p=0.01 [relative]). A simple linear regression analysis revealed a relationship between extraversion score and right posterior fusiform gyrus volume (all p<0.34). Finally, age, socioeconomic status, parental socioeconomic status, WAIS-R information subscale scores, duration of illness, and chlorpromazine-equivalent medication dose did not correlate significantly with fusiform gyrus volumes.

Discussion

Patients with schizophrenia showed a distinct NEO personality profile of increased neuroticism and decreased conscientiousness and extraversion. Reduced extraversion, in turn, correlated with abnormalities of the face-sensitive right posterior fusiform gyrus. We previously demonstrated a significant correlation between these same fusiform gyrus abnormalities and reduced facial memory recognition (4). Thus, in schizophrenia, reductions in both extraversion and facial memory correlate with smaller right posterior fusiform gyrus volumes. These empirical relationships may eventually help to elucidate the neurobiology of the social disturbance of schizophrenia. However, future studies will need to adopt a multiple-prong approach. Personality measures, symptom ratings, and neuropsychological test scores along with brain imaging will likely be necessary to capture the dynamic multivariate relationship of brain and social personality changes in schizophrenia.

References