Brief Report

Face Recognition Memory Deficits and Visual Object Memory Performance in Patients With Schizophrenia and Their Relatives

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Objective: Face recognition memory deficits in schizophrenia are attributed to frontotemporal dysfunction. Biological relatives of patients have similar deficits, suggesting genetic susceptibility. Because the impairment may reflect generalized object memory deficits, the authors evaluated both face and visual object recognition.

Method: The Penn Face Memory Test and Visual Object Learning Test were given to 102 patients with schizophrenia, 60 of their biological relatives, and 135 healthy comparison subjects.

Results: Significant immediate and delayed face recognition deficits were observed in patients and their relatives. Although patients were more impaired in visual object memory than comparison subjects, relatives were not.

Conclusions: Face recognition deficits in patients with schizophrenia and their families are not secondary to generalized object memory deficits and may be an endophenotype reflecting frontotemporal impairment.

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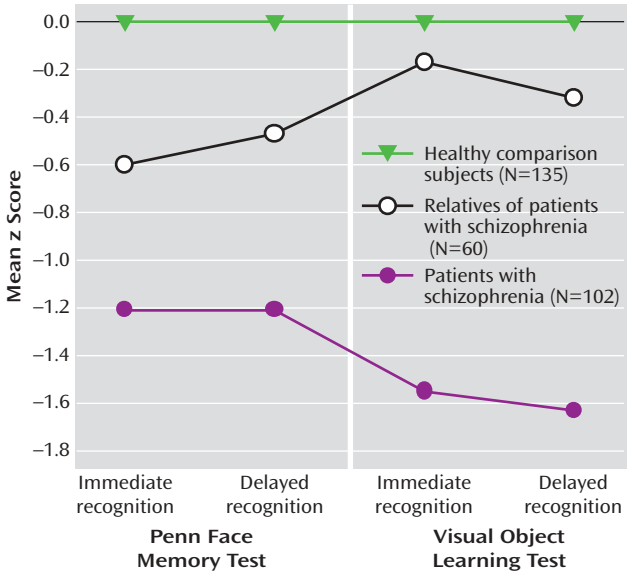
Evaluation of specific versus generalized cognitive deficits in schizophrenia remains a challenge (1, 2), but deficits in particular domains can suggest candidate endophenotypes to assist in gene identification. Patients with schizophrenia are impaired in facial recognition (3), implicating frontotemporal circuits (4), but whether this reflects a generalized memory deficit is unclear. Conklin et al. (5) reported that 33 healthy first-degree relatives of patients with schizophrenia were also impaired in face memory (according to Wechsler Memory Scale, 3rd ed., scores) compared with 56 healthy subjects. Impairment in relatives suggests that observed deficits in patients might be associated with genetic susceptibility and not attributable to confounding effects of chronic illness. In the study by Conklin et al., face recognition deficits were not accounted for by verbal memory and spatial attention deficits, but a more generalized nonverbal object memory deficit was not assessed. Lesion and neuroimaging studies suggest separate processing nodes for faces and other nonverbal objects. To shed light on this phenomenon, we evaluated both face recognition memory and visual object memory in patients, their relatives, and healthy subjects.

FIGURE 1. Face and Visual Object Recognition Memory Performance in Patients With Schizophrenia, Their Relatives, and Healthy Comparison Subjects[a]



[a] Significance results are of post hoc comparisons (Tukey's least significant difference) following significant repeated-measures analyses of variance. d=Cohen's estimate of magnitude of mean difference between healthy comparison subjects and the index group (schizophrenia or relative). For the comparison between healthy subjects and patients with schizophrenia, d=1.10 (p<0.001) for immediate and d=1.05 (p<0.001) for delayed face recognition memory and d=1.33 (p<0.001) for immediate and d=1.36 (p<0.001) for delayed visual object recognition. For the comparison between healthy subjects and relatives of patients with schizophrenia, d=0.61 (p<0.001) for immediate and d=0.47 (p<0.01) for delayed face recognition and d=0.17 (n.s.) for immediate and d=0.34 (n.s.) for delayed visual object recognition.

Method

Participants were from the Schizophrenia Research Center, University of Pennsylvania (3); 102 were patients with schizophrenia, 60 were relatives of these patients, and 135 were healthy subjects. The patients and healthy subjects ranged in age from 18 to 65 years. Thirty-seven (36%) of the patients with schizophrenia were women, and 91 (89%) were right-handed; their mean age was 32.4 years (SD=11.4), their mean parental education level was 12.7 years (SD=3.8), and their mean Brief Psychiatric Rating Scale (BPRS) score was 36.7 (SD=9.7). Sixty-eight (50%) of the healthy comparison subjects were women, and 113 (84%) were right-handed; their mean age was 27.8 (SD=8.1), and their mean parental education level was 13.4 years (SD=4.1). Healthy participants had no family history of psychiatric illness. All ascertainable first-degree relatives (N=60) of patients were included in the study. Twenty-nine (48%) of the relatives were women, and 52 (87%) were right-handed; their mean age was 45.0 (SD=16.5), and their mean parental educational level was 13.4 years (SD=4.8). After complete description of the study, written informed consent was obtained from all participants.

Subjects completed a battery of computerized neurocognitive tasks, including the Penn Face Memory Test (6) and the Visual Object Learning Test (7). Both measures assess recognition immediately following stimulus presentation and after a 20-minute delay.

Results

Distributions of Penn Face Memory Test and Visual Object Learning Test scores departed from normality (Kolmogorov-Smirnov p<0.01). Dependent variables were therefore converted to percent correct, arc-sine transformed, and converted to z scores by using healthy group data.

Analysis of variance (ANOVA) revealed that patients and their relatives were older than comparison subjects (F=42.9, df=2, 295, p<0.001). Therefore, age was addressed in subsequent analyses. Sex was balanced across groups, although there was a trend toward disproportion (χ^2=4.98, df=1, p=0.08). Follow-up chi-square tests revealed a similar number of men and women in the group of relatives and the healthy comparison group (χ^2=0.02, df=1, n.s.) but a disproportionate number of men in the patient group (χ^2=7.50, df=1, p<0.01). Subsequent analyses considered the influence of gender among patients.

Parental education did not differ among groups (F=0.75, df=2, 256, p=0.47), and handedness was equally distributed (χ^2=2.93, df=4, p=0.57). BPRS scores were not correlated with Penn Face Memory Test or Visual Object Learning Test scores (p>0.06). These variables were not considered further.

Repeated-measures ANOVA, with Penn Face Memory Test (immediate and delayed) as the within-subjects factor and group (schizophrenia, relative, or comparison) as the between-subjects factor showed a main effect of group (F=46.47, df=2, 293, p<0.001) and no group-by-measure interaction (F=0.24, df=2, 293, p=0.47). Follow-up one-way ANOVAs and post hoc tests (Tukey's least significant difference) were performed to identify sources of the group effect. Patients recognized fewer faces than healthy subjects in both immediate and delay conditions (Figure 1). Relatives recognized fewer faces than healthy subjects and more faces than patients in both conditions. There were no differences in performance between immediate and delayed recognition on the Penn Face Memory Test; patients and relatives were more impaired than healthy subjects in both immediate and delayed face memory. Results were similar for the Visual Object Learning Test (F=46.41, df=2, 161, p<0.001), but in follow-up tests, relatives did not differ from comparison subjects.

Analysis of covariance (ANCOVA) revealed age as a significant covariate (p<0.01), but pairwise ANCOVAs between relatives and healthy comparison subjects yielded the same results as those shown in Figure 1. Moreover, in both patients and relatives, correlations between face memory and age were small and nonsignificant. Correlations were significant but small in the comparison group (r=–0.24, N=135, p<0.005, for immediate recognition; r=–0.20, N=135, p<0.05, for delayed recognition), accounting at most for 4% of the variance. Thus, ANCOVA and correlation analyses suggest that the deficit in relatives was not attributable to age differences.

Because some relatives had conditions for which comparison subjects were excluded, data were reanalyzed with only the medically and psychiatrically healthy relatives, age ≤65 years (N=28). Results were unaltered. Because some patients and relatives came from the same families,

some observations are not independent. We repeated the analyses comparing relatives and comparison subjects with one relative per family (closest in age to the patient) (N=35); again, results were unchanged. Finally, we conducted within-participant group t tests using sex as a grouping variable. Men and women did not differ, indicating that the preponderance of men did not account for impairment in schizophrenia.

To assess the robustness of the face memory deficit, we conducted receiver-operating-curve analyses, which provide an index of sensitivity and specificity. The area under the curve value indicates the ability of a measure (face memory) to differentiate between two groups (1.0=perfect discriminability, 0.5=groups overlap completely). Relative to healthy subjects, area under the curve values were highly significant for measures of face memory in patients (area under the curve=0.78, SE=0.03, $p<0.001$, for immediate recognition; area under the curve=0.77, SE=0.03, $p<0.001$, for delayed recognition) and relatives (area under the curve=0.69, SE=0.04, $p<0.001$, for immediate recognition; area under the curve=0.65, SE=0.04, $p<0.002$, for delayed recognition). Thus, both immediate and delayed face memory robustly differentiate patients with schizophrenia and their relatives from healthy people.

We used Pearson bivariate correlation coefficients to assess relationships among the four dependent variables. With two exceptions, correlations were similar within each group and were moderate (r=0.30–0.67, all $p<0.05$). Correlations were small and nonsignificant between Penn Face Memory Test immediate recognition and Visual Object Learning Test delayed recognition in comparison subjects (r=0.21) and between Penn Face Memory Test delayed recognition and Visual Object Learning Test immediate recognition in relatives (r=0.27).

Discussion

Patients with schizophrenia showed pronounced deficits in both face recognition and visual object recognition memory. These results appear consistent with a generalized memory deficit in schizophrenia. However, evaluation of neuropsychological deficits in patients could be confounded by variables associated with chronic illness, including medications. First-degree relatives typically do not share these confounding variables but do share genetic susceptibility for schizophrenia. First-degree relatives in this study showed impairment in face recognition but not in visual object recognition memory and learning. These results were upheld when we evaluated several variables that could contribute to deficits in relatives. Thus, our study independently replicates the finding of face recognition memory deficits in relatives (5), using a different large study group and an alternative face memory task.

Because relatives of patients with schizophrenia did not exhibit impairment in visual object learning memory, the results support the idea that face recognition memory deficits in families with schizophrenia are not secondary to generalized nonverbal memory deficits. Effect sizes for Visual Object Learning Test performance were larger than those for the Penn Face Memory Test (immediate and delayed recognition) in patients, while the opposite was true in relatives. This dissociation indicates that patients do not show a pronounced Visual Object Learning Test deficit because the test is more difficult or has greater discriminability than the Penn Face Memory Test. If relatives had generalized nonverbal memory impairment and the Visual Object Learning Test had greater discriminability, we would expect relatives to perform worse than comparison subjects, which did not occur. Impairment in patients in the absence of impairment in relatives suggests that visual object learning may be more susceptible to state-related factors affecting patients. This interpretation is consistent with previous work suggesting that visual object but not face memory is influenced by medication (8).

The Visual Object Learning Test delay condition is not strictly parallel to the Penn Face Memory Test delay condition because participants are afforded multiple learning trials. We are collecting family data with an object recognition memory task that more closely parallels the Penn Face Memory Test. Nonetheless, the results support the hypothesis that a face recognition deficit is a candidate endophenotype, reflective of frontotemporal dysfunction associated with the genetic liability for schizophrenia.

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