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Eye Tracking, Schizophrenic Symptoms, and Schizotypal Personality Disorder

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Summary. Schizophrenic patients and patients with schizotypal personality disorder were significantly more likely than normal controls to demonstrate impaired eye tracking performance. Fifteen of 27 schizophrenics and 15 of 27 schizotypals had impaired eye tracking, compared with 11 of 39 normal controls. In the schizophrenic group, including 10 out-patients in a stable state of relative remission, impaired eye tracking was associated with more severe formal thought disorder and more time spent in psychiatric hospitals. Among stable schizophrenic out-patients, poor eye tracking was related to more severe formal thought disorder and greater overall psychopathology. This pattern of results suggests a possible relation between eye tracking impairment and more severe enduring symptoms across the spectrum of schizophrenic and schizophrenia-related disorders.

Key words: Eye tracking – Schizotypal personality disorder – Schizophrenia – Enduring symptoms – Formal thought disorder

Introduction

Eye tracking has been shown to be impaired in individuals across the spectrum of schizophrenic and schizophrenia-related disorders. Eye tracking dysfunction is associated with schizophrenia in 51% to 85% of schizophrenic patients, in contrast to a normal population prevalence estimated at 8% (Holzman et al. 1973, 1974). Schizophrenic patients judged to be in a psychosis-free state of relative remission demonstrate more severe eye tracking dysfunction than normal controls or remitted affective disorder patients (Iacono et al. 1982). In normal volunteer populations, poor eye tracking has been associated with psychiatric symptoms believed to be related to schizophrenia, such as social isolation (Siever et al. 1982), physical anhedonia and perceptual aberration (Simons and Watkins 1985), and a diagnosis of DSM-III schizotypal personality disorder (Siever et al. 1984).

Impaired eye tracking seems to be an abnormality with a genetic component, as it is observed twice as frequently in monozygotic twins as in dizygotic twins (Holzman et al. 1980), and a significantly greater proportion of parents of schizophrenic patients have eye tracking impairment compared with the parents of manic-depressive patients and normal controls (Holzman et al. 1984). These and other data have been interpreted by some investigators as indicating that an autosomal dominant gene determines a single latent trait that is variably expressed as schizophrenia and/or eye tracking impairment (Matthysse et al. 1986; Holzman et al. 1988). This interpretation of the eye tracking data to date suggests that eye tracking impairment may provide useful information for the determination of affected cases in studies investigating the molecular genetics of schizophrenia. Toward this end, the nature of the relation between eye tracking impairment and the spectrum of schizophrenic illnesses, from chronic, unremitting schizophrenia to schizophrenia-related personality disorders such as schizotypal personality disorder, needs to be more clearly delineated. What diagnostic entities along the schizophrenia spectrum are associated with eye tracking impairment and how is eye tracking impairment related to the clinical characteristics of schizophrenia and other schizophrenia-related disorders? In order to address these issues, these studies investigated the relation between eye tracking impairment and the severity of illness and symptomatology of schizophrenic patients, including a subgroup of patients in a stable state of relative remission, and assessed the presence of eye tracking impairment in patients diagnosed

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with schizotypal personality disorder in a clinical setting.

Patients and Methods

Patients. The sample consisted of 27 male chronic schizophrenic patients, 27 patients with schizotypal personality disorder, and 39 normal controls. The ages of the schizophrenic patients (36.9 ± 12.0), schizotypal patients (38.2 ± 10.5), and the normal controls (36.8 ± 14.6) were very similar. All subjects participated in this study after informed consent as approved by the institutional human subjects committee.

All patients participating in the study were identified from the in-patient and out-patient units of the Bronx Veterans Administration Medical Center. The normal controls were recruited through newspaper advertisements and screened to exclude a personal or family history of psychiatric illness including both Axis I and Axis II disorders by an interview with a psychiatrist. A comprehensive medical evaluation was performed to screen out subjects with medical illness. Patients and controls were kept free of medications for two weeks prior to testing. Schizophrenic patients may have received chloral hydrate within this interval, but not within 24 h of eye tracking testing. All out-patients and normal controls were instructed to abstain from alcohol for 24 h prior to testing. All schizophrenic patients were interviewed by a two-member diagnostic team that used the Schedule for Affective Disorders and Schizophrenia (SADS; Endicott and Spitzer 1978) in order to diagnose patients by the Research Diagnostic Criteria (RDC; Spitzer et al. 1978) ($K = 0.80$). Schizophrenic patients met criteria for definite schizophrenia or schizoaffective disorder, mainly schizophrenia according to the RDC. They were separated into three clinical groups: stable, exacerbated, and Kraepelinian. Stable patients ($n = 10$) were all volunteers who were in a state of relative remission compared to their periods of exacerbation requiring hospitalization. By definition, they were not in need of hospitalization for the 3 months before they were studied. They received four weekly scores on the Brief Psychiatric Rating Scale (BPRS; Overall and Gorham 1962) with a range of less than 10 points (mean $\pm$ SD = 27.0, $\pm$ 4.1). Seven of these patients had RDC diagnoses of residual schizophrenia, while two were diagnosed as not currently mentally ill, with a past history of schizophrenia, and one met RDC criteria for undifferentiated schizophrenia. The Kraepelinian group ($n = 4$; mean BPRS = 42.5 ± 6.7) met the following criteria for the preceding 5 years: (1) either continuous hospitalization or (2), if living outside the hospital, (a) complete dependence on others for necessities such as food, shelter, and clothing; (b) no useful work or employment; and (c) no evidence of a remission of symptoms. Patients in the exacerbated group ($n = 13$; mean BPRS = 45.5 ± 7.7) required hospitalization, but did not meet the criteria for the Kraepelinian group.

Schizotypal patients were interviewed with the Schedule for Interviewing DSM-III Personality Disorders (SIDP; Stangl et al. 1985) by two raters. A third rater interviewed an informant close to the patient. Consensus diagnoses of schizotypal personality disorder were determined in a meeting of all raters ($K = 0.77$ for schizotypal personality disorder) according to the criteria of the Diagnostic and Statistical Manual of Mental Disorders, third edition (revised) (DSM-III-R; American Psychiatric Association 1987).

Assessment of Eye Tracking. Subjects were set one meter from a pendulum set to move in a standardized arc with an oscillation frequency of 0.4 Hz and a target excursion of 20 degrees of the visual angle. Before each 30 s trial, subjects were told to keep their head as still as possible, to refrain from blinking, and to try to keep their eyes focused on the stimulus. Electrodes were placed at the outer canthus of each eye and a ground was placed at mid forehead. Eye position and velocity were recorded on a electrooculograph (EOG).

Eye tracking records were scored by two experienced raters who were blind to the diagnosis of the subjects. Raters used the qualitative rating scale of Shagass et al. (1974), with which the best eye tracking records are given a score of "1" and the worst are given a score of "5". Inter-rater reliability was high ($ICC = 0.95$). A qualitative score of > 2.5 was considered to reflect poor eye tracking (Holzman et al. 1984).

Clinical Assessment of Schizophrenic Patients. For all schizophrenic patients, severity of formal thought disorder was measured by the Thought, Language, and Communication Scale (TLC; Andreasen 1979). Current social and occupational functioning was measured with the Level of Functioning Scale (LFS; Strauss and Carpenter 1974). Negative symptoms were assessed by determining total scores (excluding global and subjective rating scores) on the Scale for the Assessment of Negative Symptoms (SANS; Andreasen 1982). Positive Symptom Severity scores (Rosen et al. 1984), which estimate scores obtained from the Scale for the Assessment of Positive Symptoms (Andreasen 1984) were determined by summing SADS items rating severity of hallucinations, delusions, bizarre behavior, and positive formal thought disorder. Positive symptoms were also determined by the number of RDC schizophrenic symptoms (the "A" criteria) manifested. Overall severity of psychopathology was asssessed by Clinical Global Impression (CGI) scores. Data regarding number of psychiatric hospitalizations and total time in psychiatric hospitals were gathered for all schizophrenic patients.

Results

The distribution of SPEM qualitative rating scores is presented in Fig. 1. Fifteen of the 27 schizophrenics were judged to have poor eye tracking (scores of greater than 2.5 on a 5 point scale), 15 of the 27

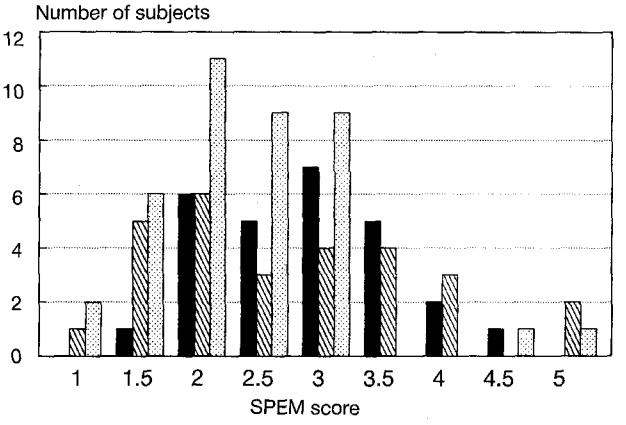

Fig. 1. SPEM qualitative ratings of schizophrenics ■ (n = 27), schizotypals ▨ ($n = 27$) and normals ▩ ($n = 39$). $\chi^2 = 6.89$, $df = 2$, $P < .05$

Table 1. SPEM and formal thought disorder in schizophrenic patients

SPEM	*n*	TLC score
Good	12	5.8
Poor	14	12.9

$t = 2.23$, $df = 24$, $P = 0.03$

Table 2. SPEM and formal thought disorder in stable schizophrenic patients

SPEM	*n*	TLC score
Good	5	1.4
Poor	5	7.8

$t = 2.39$, $df = 8$, $P = 0.04$

schizotypals had poor eye tracking, while 11 of the 38 normals demonstrated poor eye tracking ($\chi^2 = 6.59$, $df = 2$, $P < 0.05$). The quality of eye tracking was similar among the different clinical groups of schizophrenics. Five of 10 stable schizophrenics, 7 of 13 exacerbated schizophrenics and 3 of 4 Kraepelinian schizophrenics demonstrated poor eye tracking. Age was not significantly correlated with quality of eye tracking in schizophrenics ($r = 0.30$; $df = 25$; $P = 0.14$), schizotypals ($r = -0.18$; $df = 25$, n.s.), or normals ($r = -0.10$; $df = 36$, n.s.). Age was very similar among the three groups.

Among schizophrenic patients, poor eye trackers had a significantly more severe formal thought disorder as measured by the TLC than did good eye trackers (see Table 1). Interestingly, this difference was particularly great in stable schizophrenics, who were living outside the hospital with low levels of psychopathology. Stable schizophrenics with poor eye tracking had significantly more severe formal thought disorder than stable schizophrenics with good eye tracking (see Table 2). There was a nonsignificant tendency for poor eye trackers to have higher Clinical Global Impression (CGI) scores than good eye (4.2 ± 1.2 vs. 3.3 ± 1.4; $t = 1.63$; $df = 24$; $P = 0.12$). Among 10 stable schizophrenic patients, poor eye trackers had significantly greater CGI scores, indicating greater overall psychopathology (3.0 ± 0.7 vs. 2.0 ± 0.7; $t = 2.24$; $df = 8$; $P = 0.05$). Poor eye trackers spent significantly more months in psychiatric hospitals than good eye trackers (18.4 vs. 8.6; $t = 2.53$; $df = 23$; $P = 0.02$), although they were not significantly older. Good and poor eye trackers were not significantly different on measures of severity of positive and negative symptoms, or number of psychiatric hospitalizations.

Discussion

In a group of schizophrenic patients, schizotypal patients, and normal controls, poor eye tracking was found to be equally prevalent in the schizophrenic and schizotypal groups, both of which contained more poor eye trackers than a group of normal controls. Among schizophrenic patients, poor eye tracking was associated with more severe formal thought disorder and more time spent in psychiatric hospitals. Among schizophrenic patients living outside the hospital in a state of relative remission, poor eye tracking was associated not only with formal thought disorder, but also with overall clinical impression.

Demonstration of equally impaired eye tracking in schizotypal and schizophrenic individuals compared with normal controls provides support for the view that eye tracking dysfunction is associated with the less overtly psychotic "core" features of the schizophrenia spectrum (Siever et al. 1982; Simon and Watkins 1985). These features, such as social isolation, flattened affect, and eccentricity have been speculated to be more strongly associated with the genetic relationship to schizophrenia than psychosis or psychotic-like symptoms (Siever and Gunderson 1985; Dworkin and Lenzenweger 1983, 1984). Thus, the increased prevalence of eye tracking impairment in schizotypals offers support for the putative association of eye tracking dysfunction, the enduring "core" characteristics of schizophrenia, and the genetic component of the illness.

Eye tracking impairment may also be related to some of the enduring features of schizophrenia. In this study, eye tracking dysfunction was related to formal thought disorder, expecially in patients who were living outside the hospital in stable states of remission relative to their periods of exacerbation. These data are consistent with previous findings suggesting a relation between eye tracking impairment and thought disorder independent of diagnosis (Solomon et al. 1987). It is possible that eye tracking impairment is a correlate of a more severe course of illness, characterized by periods of stability that are accompanied by greater psychopathology. Although speculative, this notion is supported by the increased CGI scores in stable patients living outside the hospital with poor eye tracking in this study. In addition, poor eye trackers spent more time in psychiatric hospitals than good eye trackers, suggesting a worse course of illness in these patients.

These results need not necessarily be viewed as reflecting an association between poor eye tracking and overall severity of state-related psychopathological symptoms. Although the small sample size of this study precludes conclusions based on negative find-

ings, clinical global impression was not significantly related to poor eye tracking among exacerbated patients or among the entire sample of schizophrenics in this study. In addition, nearly identical percentages of remitted and exacerbated patients demonstrated poor eye tracking. These results are consistent with the notion that poor eye tracking may be related to certain enduring symptoms of schizophrenia without necessarily being related to overall psychopathology and clinical state.

One potential confounding factor in these data is the putative relation between age and eye tracking dysfunction (Kuechenmeister et al. 1977). Although correlations between age and eye tracking impairment were not significant in this study, age may have had an impact on the relations presented. The correlation in schizophrenics between eye tracking impairment and time spent in psychiatric hospitals may be mediated by age, as the correlation between age and time spent in psychiatric hospitals was strong ($r = 0.61$; $df = 25$; $P = 0.001$). However, the correlations between age and formal thought disorder ($r = -0.07$, $df = 25$, n.s.) and age and CGI score ($r = 0.09$, $df = 25$, n.s.) were not significant, suggesting that the relation between eye tracking impairment and these clinical variables was not caused by age effects.

Although the interpretation of some of these data must remain speculative owing to small sample sizes in the subgroups of schizophrenic patients, the overall pattern of results, including data from schizotypal and schizophrenic patients, suggests that eye tracking impairment may be related to enduring features of the spectrum of schizophrenic illnesses, including schizotypal personality disorder, formal thought disorder, and greater overall psychopathology during periods of relative remission.

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