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# Abnormal visual scan paths: a psychophysiological marker of delusions in schizophrenia

Mary L. Phillips \*, Anthony S. David

*Department of Psychological Medicine, King's College Hospital and Institute of Psychiatry, 103 Denmark Hill,  
London SE5 8AZ, UK*

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## Abstract

The role of the visual scan path as a psychophysiological marker of visual attention has been highlighted previously (Phillips and David, 1994). We investigated information processing in schizophrenic patients with severe delusions and again when the delusions were subsiding using visual scan path measurements. We aimed to demonstrate a specific deficit in processing human faces in deluded subjects by relating this to abnormal viewing strategies. Scan paths were measured in six deluded and five non-deluded schizophrenics (matched for medication and negative symptoms), and nine age-matched normal controls. Deluded subjects had abnormal scan paths in a recognition task, fixating non-feature areas significantly more than controls, but were equally accurate. Re-testing after improvement in delusional conviction revealed fewer group differences. The results suggest state-dependent abnormal information processing in schizophrenics when deluded, with reliance on less-salient visual information for decision-making. © 1998 Elsevier Science B.V.

**Keywords:** Visual scan paths; Persecutory; Delusions; Schizophrenia

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## 1. Introduction

Delusions are a core feature of psychosis and are particularly evident in paranoid psychoses such as schizophrenia. One popular explanation of delusion formation is that they result from the rational interpretations of abnormal experiences (Maher, 1974). Evidence consistent with this theory has come from studies of deluded subjects with perceptual deficits (Kay et al., 1976) and with facial processing deficits (Ellis and Young, 1990). Other studies have emphasized abnormalities in attention

or information processing in subjects with persecutory delusions, who selectively attend to threatening events (Kaney et al., 1992; Ullman and Krasner, 1969). An alternative theory has emphasized the role of abnormal reasoning (Hemsley and Garety, 1986; Garety et al., 1991; Garety and Hemsley, 1994), with studies demonstrating that deluded subjects require less information before reaching a decision compared with non-deluded subjects, i.e. they have a tendency to 'jump to conclusions'.

These purely cognitive approaches to uncovering the basis of delusions suffer since they cannot easily provide a means of measuring information processing in deluded subjects in real time. The

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\* Corresponding author. Tel: +44 171 740 5078; Fax: +44 171 740 5129.

measurement of visual scan paths is one method that, potentially, enables this to occur.

### *1.1. Visual scan paths: parameters*

The visual scan path is a map that traces the direction and extent of gaze when an individual comprehends a complex scene (Noton and Stark, 1971), i.e. a psycho-physiological 'marker' of sensory input and directional attention on viewing a stimulus. The measurements include fixations, defined as consecutive gaze positions within 1° of visual field for a duration of 200 ms or more, and voluntary saccades, i.e. voluntary eye movements in between fixations. Fixations represent 'points of attention' by a subject on viewing the stimulus. Studies have demonstrated, for example, that on viewing facial stimuli, normal subjects have a tendency to fixate features of the face (i.e. eyes, nose, mouth, ears; Walker-Smith et al., 1977; Mertens et al., 1993), with both the external features of the visual stimulus and the presence of internal schemata acting as influences on the visual scan path pattern (Rizzo et al., 1987).

### *1.2. Clinical studies*

A small number of studies have investigated visual scan paths in schizophrenic patients [reviewed in Phillips and David (1994)]. Gaebel et al. (1987) demonstrated a relationship between symptomatology and viewing pattern, with schizophrenics with positive symptoms demonstrating increased scanning (i.e. reduced fixations), and schizophrenics with negative symptoms demonstrating increased staring (i.e. increased duration of fixation). A second study (Gordon et al., 1992) demonstrated that schizophrenics, on viewing a facial stimulus, attend less, initially, to facial features compared with normal controls. A later study indicated that schizophrenics have a less efficient viewing strategy compared with normal controls on viewing picture completion figures (Kurachi et al., 1994). Visual scan path patterns therefore appear to be related to symptomatology, and schizophrenic patients as a group may use less efficient viewing strategies than normal controls.

The current study investigated the cognitive processes underlying delusions in schizophrenia

(David, 1993) using visual scan path measurements as a means of tracking information processing in deluded patients (Phillips and David, 1997). The content of delusions often revolves around a person's relationship to others and role in society rather than neutral or impersonal themes (Brennan and Hemsley, 1984; Bentall et al., 1991). It is therefore important to utilize socially-relevant stimuli when investigating delusion formation. Human faces are ideal stimuli in that they convey a wealth of socially-relevant information, such as age, gender, identity and expression (Ellis and Young, 1988). Stimuli from the Recognition Memory Test (Warrington, 1984) are useful in that they can be employed in free-viewing (single faces) and task-dependent (face pairs in the forced-choice recognition task) conditions. In addition, if only a small number of stimuli are used (e.g. eight out of the maximum number of fifty stimuli), then the recognition task is relatively straightforward. We would therefore expect all subjects to perform well on the recognition task, thereby minimizing any effect of task difficulty on visual scan path variables. We used these stimuli in order to test the hypotheses below.

Cognitive theories of delusion formation emphasize the tendency of paranoid patients to rely less on salient information prior to decision-making. We therefore predicted that patients with persecutory delusions (common in patients with paranoid schizophrenia) would view facial stimuli with reduced attention to discriminating feature areas compared with non-deluded schizophrenic and normal control subjects. Specifically, we predicted that deluded schizophrenics would look more at irrelevant features of the face compared with non-deluded subjects and normal controls both in free vision and during a specified task such as recognition. It was further hypothesized that this abnormality would become less marked on resolution of delusions at a later testing session after controlling for the effects of practice.

## **2. Method**

### *2.1. Subjects*

Patients with a diagnosis of schizophrenia (DSM-III-R criteria, American Psychiatric

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