

## Understanding the Symptoms of Schizophrenia Using Visual Scan Paths

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**Background.** This paper highlights the role of the visual scan path as a physiological marker of information processing, while investigating positive symptomatology in schizophrenia.

**Method.** The current literature is reviewed using computer search facilities (Medline).

**Results.** Schizophrenics either scan or stare extensively, the latter related to negative symptoms. Schizophrenics particularly scan when viewing human faces.

**Conclusions.** Scan paths in schizophrenics are important when viewing meaningful stimuli such as human faces, because of the relationship between abnormal perception of stimuli and symptomatology in these subjects.

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The nature of the relationship between positive symptoms of schizophrenia (such as delusions and hallucinations) and abnormalities of sensory information processing is an intriguing problem. There have been two types of theory attempting to clarify the situation. The first proposes deficits in early, automatic processing (Shiffrin & Schneider, 1977), which results in difficulties in assessing the significance of incoming stimuli. This has been linked to the theory of latent inhibition, in which schizophrenics continue to attend to redundant, predictable stimuli (Baruch *et al*, 1988).

The second type of theory proposes deficits in later levels of information processing and more directed aspects of attention, with impairment in the ability to form associations between the individual components of information and integrate them as a whole (i.e. impaired “gestalt” or configurational processing; John & Hemsley, 1992). Delusions in particular are a core feature of psychosis, and a popular explanation has been that these are the result of distorted perception of complex events and stimuli in the real world (Maher, 1974).

One problem for theories and research of this nature is making the connection between concepts of latent inhibition and selective attention, and what

our patients tell us about what they “see” going on in the world “out there”.

### Why study scan paths?

A visual scan path is essentially a map which traces the direction, extent and duration of gaze when an individual comprehends a complex scene. The eyes are drawn to points of interest, which are paralleled by the allocation of attention to the object (Noton & Stark, 1971). The visual scan path is thus a ‘marker’ of initial sensory input and directed attention, that is, a measure of both the earlier and later levels of information processing discussed above. Measurement of visual scan paths in schizophrenia therefore allows us to study the relationship between symptomatology (and delusions in particular) and the way sensory information is processed in real time.

### The measurement of scan paths

Scan paths consist of two types of eye movement: fixations and voluntary saccades. A fixation is described as the focusing of the eye on the same position for 200 ms or more (Gaebel *et al*, 1987). Voluntary saccades are fast eye movements involving both eyes and moving the eyes from one point of interest to another. It is known that for the viewing of any object, each individual will have a different scan path (Noton & Stark, 1971). Measurement of scan paths in subjects is relatively straightforward and involves the use of an infrared light source and recording by video camera of the corneal reflections from such a source. Eye positions can be recorded every 20 ms to a precision of 0.5° (Gaebel *et al*, 1987). Parameters measured are fixation (mean duration of fixation and total number of fixations) and voluntary saccade length (total length of scan path and mean scan path length) during the viewing of the stimulus.

### Smooth pursuit eye movements

Investigation of eye movements in schizophrenia has concentrated on the study of abnormalities in smooth pursuit eye movements (SPEM) as opposed to scan paths. The initial study of abnormalities in SPEM in schizophrenia was performed by Diefendorf and Dodge in 1908. Independent rediscovery of this by Holzman and colleagues in the 1970s has led to further studies. They demonstrate a reduction in the ratio (gain) of SPEM velocity compared with target velocity, and an increase in saccadic frequency during the smooth pursuit process, in schizophrenics compared with normal controls (Radant & Hommer, 1992).

### Current scan path research

To date, there has been little research on scan paths in schizophrenia. This probably reflects limitations in data storage and analysis hitherto, now easily dealt with by modern personal computers. Preliminary studies, however, have shown that schizophrenics may have either a pattern of extensive staring or of extensive scanning. Extensive staring behaviour has been found to occur more often in schizophrenics with negative symptoms, although it is not yet clear as to the pattern of eye movements in schizophrenics with positive symptoms and the relationship between the scan paths and information processing (Gaebel *et al*, 1987; Kojima *et al*, 1992). One problem has been the difficulty in separating cause and effect in the relationship between visual scan paths and sensory information processing. Fortunately, from the point of view of future research efforts, it has been noted that there is no significant effect of medication on the nature of scan paths (Kojima *et al*, 1992), although this has not been investigated in detail.

It is important to investigate the way in which schizophrenic subjects view relevant stimuli because of the relationship between such stimuli and symptom formation, as described above. An obvious example of such a meaningful stimulus is the human face. Studies have shown that schizophrenics are impaired in the ability to judge facial emotion (Cramer *et al*, 1989) and also "non-emotion" such as age of the face (Gessler *et al*, 1989). It has been proposed that the configuration of the face, rather than individual features or components, is of importance in the conveying of the expression (Patterson & Baddeley, 1977), which is suggestive of an impairment in facial processing at the configurational level in schizophrenia.

It is not clear, however, exactly to what extent impaired facial processing is related to the presence of positive or negative symptoms. It has been shown,

on the one hand, that abnormal facial evaluation is unrelated to either paranoid symptoms (positive) or flattened affect (negative) (Cramer *et al*, 1989). On the other hand, a greater degree of impairment of judgement of affect was found in schizophrenics in the acute stage of the illness (Gessler *et al*, 1989). It has also been demonstrated that in a patient with the Fregoli delusion of misidentification, there was an associated impairment of identification of familiar faces and of matching photographs of unfamiliar people wearing disguises with undisguised views (Young *et al*, 1990).

By measuring visual scan paths in schizophrenic subjects with positive symptoms such as delusions, it is thus possible to observe and infer the reasons behind information processing failures. For example, do the subjects simply fail to look at salient features, or do they look at all features but fail to distinguish those which are salient because of excessive eye movements directed to distracting information? The prediction of the authors is that schizophrenic subjects who are deluded will demonstrate a pattern of extensive scanning, reflecting the distraction of these subjects by irrelevant stimulus information. We also suggest that this may be responsible for the impaired configurational processing of faces already indicated by the studies demonstrating facial recognition failures and poor judgement of facial affect in these subjects. A preliminary study has, in fact, demonstrated a pattern of reduced fixation to facial features (i.e. excessive scanning) in schizophrenics compared with normal controls when viewing a facial stimulus (Gordon *et al*, 1992). No study has, as yet, related scan paths for viewing a facial stimulus to symptomatology or to visual information processing in schizophrenia. This is an area of exciting future research.

Another area of research has been to consider potential anatomical lesions responsible for scan path abnormalities in schizophrenic subjects. A study of scan paths in subjects with simultanagnosia demonstrated that although the subjects reported fragmentary perception of the visual environment, such subjects had normal scan paths when viewing complex stimuli such as faces and scenes. It was suggested that this was evidence for the presence of a separate anterior system directing visual attention and driving visual searching behaviour (scan paths) but not allowing higher level, conscious experience of the visual stimulus (Rizzo & Hurtig, 1987). It is this anterior system which may well be functioning abnormally in schizophrenia. A preliminary study (Matsushima *et al*, 1992) has indeed demonstrated that the visual scan paths in subjects with right frontal lobe lesions and patients with schizophrenia

are different from those of normal control subjects, with fewer fixations and also shorter scan path lengths.

### Conclusions

Investigation of scan paths in schizophrenia has led to evidence of either increased staring or increased scanning compared with normal control subjects, with the staring behaviour related to negative symptomatology. The exact relationship between scan paths and symptomatology is still poorly understood, however, especially in schizophrenics with positive symptoms such as delusions. It is schizophrenics with positive symptoms who are of particular interest in view of their often markedly disordered perception of the world. It will therefore be important to investigate the nature of scan paths in schizophrenics with positive symptoms, and how this reflects visual information processing in such subjects.

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## Childhood Sexual Experiences with Adults: Adult Male Psychiatric Patients and General Practice Attenders

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**Background.** Sexual abuse of male children is now believed to be common, and there may be links to adult psychiatric disorders.

**Method.** Recollections of sexual experiences with adults in childhood were studied systematically in 115 men attending general practice surgeries and 100 male psychiatric patients.

**Results.** The latter reported more frequent and more serious events before the age of 13 than the general practice attenders. No significant difference was detected for events between the ages of 13 and 15.

**Conclusions.** Childhood sexual abuse before the age of 13 may be associated with later psychiatric disorders, although the nature of the association remains uncertain.