

## Eye Movements and Psychopathology

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**Summary.** The article outlines in brief why psychiatrists use disturbances of various types of eye movements as biological indicators of functional disturbances of brain systems that may be linked to psychopathology, as well as by which strategies these indicators will be applied. Basic as well as specific questions that remain to be resolved are addressed.

**Key words:** Eye movements – Psychopathology

### Introduction

As early as 1908, Diefendorf and Dodge described disturbances of both smooth pursuit (SP) and saccadic (S) eye movements (EM) in schizophrenic patients. After a few similar observations during the following decades, the publication of Holzman et al. (1973) on SPEM disturbances initiated a series of investigations which were reviewed by Erlenmeyer-Kimling (1987). She concluded that “SPEM dysfunction still appears to be one of the strongest candidates for a biological marker currently available”. However, some researchers have stressed problems in recording and analysing SPEM disturbances and have doubted their nosological specificity. In 1982 Becker et al. emphasized that only disturbances of SEM, especially dysmetric undershooting of a saccadic target tracking, may be specific to schizophrenia.

Answers to questions posed by such problems are embedded in a more general research strategy (Helmchen and Gaebel 1987; Helmchen 1988). Hence, as with all other variables, the clinician has to question the validity of various distinct parameters of EM disturbances as biological markers for a nosologically specific vulnerability. This may be defined by significant preva-

lence (a) in only one nosological group, (b) in first-degree relatives of such patients, (c) and also between acute states, i.e. as more or less time-invariant trait characteristics. Furthermore, the primary interest of the clinician is to question the predictive validity of such parameters in the context of the more widespread search for variables. These are mainly biological ones, with predictive validity for both the spontaneous course, and, more importantly, for the response to therapy. In addition it should be determined whether and which parameters of these EM disturbances are dependent on age, sex and therapy.

These questions arose from and have been related mainly to the study of schizophrenia. However, because of the yet unsolved problems of heterogeneity and clinical validity of current diagnoses of schizophrenia, aetiopathogenetic research in schizophrenia should also start with variables that are defined and measurable and, hence, reliably recognizable, such as eye movements. Since such a variable can probably define a more homogeneous group than one of the conventional and heterogeneous schizophrenia diagnoses, it should also be tested as an independent variable. This reversal of the traditional variable dependency is a paradigm introduced as the biological high-risk approach by Buchsbaum et al. (1976) and has been called the “select-by-marker” strategy instead of the usual “select-by-diagnosis” strategy by Siever and Coursey (1985).

Answers to the clinical questions are not only of clinical significance but may also indicate whether the variable should be a candidate for pathogenetic research. Strategies aiming more particularly at the pathophysiology are the above-mentioned “select-by-marker” strategy and a, as it were, “vertical” strategy. This is directed to the relationship of the index variable to other variables at various levels between the surface of the clinical phenomena and the underlying pathogenetic or even aetiological conditions.

Thus, the inter-relationship should be investigated between variables at the clinical level, e.g. measurable parameters of psychopathology or of course and outcome [as Kahlbaum (1863) and Kraepelin (1899) fairly successfully started to do more than 100 years ago]; variables at an aetiology-related molecular level, e.g. by type and degree of genetic influence; and variables at a level in-between, which are presumably more related to pathogenetic linkage between aetiology and clinical syndromes – an inter-related common pathway named *ätiologisches Zwischenglied* by Bonhoeffer in 1912 – such as experimental measures of sensitivity to stress or reaction to treatment.

In the light of such a more general background of research strategies, EM disturbances can be used as indicators at a level in-between psychopathology and more basic neurobiological levels.

EM disturbances are seen as of psychiatric relevance not only from the cited empirical findings but also for theoretical reasons because of the fundamental interdependence of perception and movement – the *Gestaltkreis*, as von Weizsäcker (1950) has termed it – and this extremely fine regulated sensorimotor circle's dependence on or interdependence with cognitive and affective phenomena. This interdependence can be studied in a particularly differentiated way in EM, because the systems of EM control have been intensively investigated neurobiologically and can now be investigated clinically by highly sophisticated techniques. The direction of research goes from the rough observation of these complex phenomena to a consideration of the parameters and the investigation of the differential inter-relationships of such parameters. Also there is a need for interdisciplinary cooperation, e.g. by bioengineers, neurophysiologists, neuropsychologists, and psychiatrists who are interested in brain function.

Questions are aimed at those sections of the sensorimotor eye movement circle that may be defective, at the kind and degree of such potential deficits, and at their conditions and consequences. Thus, the current interest is mainly directed to the inter-relationship between disturbances at a more neurophysiological level of SPEM and SEM, and at a more neuropsychological level of gaze and its control by affective influences, e.g. emotional pictures, and by cognitive influences, e.g. semantic tasks. Investigations at a more neurotopographical level have been started with neuro-imaging techniques in order to seek regional deviations, in general: anterior versus posterior, right versus left, cortical versus subcortical (Gaebel 1988), or more specifically, e.g. reduced blood perfusion in distinct prefrontal areas or changed distribution of distinct receptor densities.

Using EM disturbances as a tool in psychiatric research we are confronted with some unsolved basic

problems. Impairments of EM are not unequivocal indicators of the presence of a psychopathological state, and the relationship between the oculomotor impairment and psychopathology is still rather poorly understood. In particular these are mainly the direction and kind of relationship between EM disturbances and perception as well as attention deficits, or the relationship between attention and motivation, or between arousal and activation – not to speak of the vagueness of some of these concepts. We must also question definition, measurement, analysis, significance and applicability of the different parameters of EM, and – not least – a neurophysiologically adequate interpretation of them. But, nevertheless, EM disturbances seem to be a promising lead to increased understanding of higher nervous activity and its significance for psychopathology.

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