Preferential Cerebral Hemispheric Activation in Prepsychotic Schizotypes

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Abstract

This study investigated the hypothesis of left hemisphere hyperarousal in subjects who score high on one or more measures of schizotypic signs. These subjects are hypothesized to be at risk for schizophrenia. Three dependent measures of laterality preference were used: Tonic skin conductance levels; Skin conductance responses in an habituation paradigm; and Conjugate lateral eye movements. Tonic skin conductance levels showed a trend in the direction opposite to the hypothesis (right hemisphere hyperarousal in schizotypes). The skin conductance response measure showed a highly significant effect which was also opposite to prediciton. No group differences were found on the eye movement measure. Several interpretations of these findings were discussed.

The "high-risk" strategy for determining vulnerability factors related to the etiology and development of schizophrenia has received considerable research attention over the past decade. This paradigm involves intensive scrutiny of individuals who have not yet developed the clinical form of the disorders (asymptomatic), but who are presumed to have a greater likelihood of developing the full-blown disorder in the future than a randomly selected person. The identification of these predisposed subjects has relied on several approaches: offspring of an effected biologic parent (e.g., Mednick, 1978), biochemical variables such as excretion of urinary phenylethylamine (Wyatt, Potkin, & Murphy, 1979), psychophysiological measures (e.g., electrodermal activity; Gruzelier,1983), and self-report questionnaires of behavioral variations and parameters believed specific to the disorder (e.g., Intense Ambivalence scale; Raulin, 1984).

The psychometric strategy using self-report questionaires is based on Meehl's (1962) concept of schizotypy. Meehl defines schizotypy as a probable life-long characterological deficit which represents a major risk factor for developing schizophrenia. Relying on this model, Chapman and his colleagues have developed several self-report measures that assess the presence of personality characteristics suspected to be present in schizotypes and, therefore, predictive of risk for schizophrenia. The schizotypy scales include Physical Anhedonia which identifies widespread deficit in pleasure capacity (Chapman, Chapman, & Raulin, 1976), Perceptual Abberation which taps beliefs and perceptions of change in size, boundaries, appearance, and spatial relation of one's body (Chapman, Chapman, & Raulin, 1978), Somatic Symptoms which measures a collection of symptoms such as periodic fine motor dyscontrol or sensory dysfuncion, body temperature fluctuations etc. thought to be characteristic of subjects with minimal brain damage (Raulin, Chapman & Chapman, 1978), and Intense Ambivalence which assesses report of intense contradictory or rapidly shifting feelings toward people (Raulin, 1984). Generally, these scales have been very successful in differentiating schizophrenic and normal subjects, and have also been useful in the identification of individuals who deviate from

control subjects in a number of ways similar to schizophrenics (Grove, 1982).

Psychophysiological assessment of schizophrenics has discovered a number of variables which might be useful for the selection of vulnerable individuals. These include measures of arousal, information processing, attention, response sets, and habitutation. Perhaps most promising among these are hemispheric asymmetries, which have been demonstrated with a wide range of methodologies: motoric, sensory, electrophysiological, neuropsychological, and structural (anatomical) (Newlin, Carpenter, & Golden, 1981). With schizophrenic populations these studies generally have shown an overactivated (hyperaroused) and dysfunctional left hemisphere.

Two methodologies have been used to evaluate the hyperarousal hypothesis. These include: bilateral recordings of electrodermal activity and conjugate lateral eye movements (CLEMS) in response to reflective questions. The first of these was initially investigated by Gruzelier (1973) and Gruzelier and Venables (1974), who reported electrodermal underresponding on the left (as compared to the right) hand of schizophrenics, a finding indicative of left hemispheric hyperarousal. Normal control subjects have tended to display essentially symmetrical electrodermal responses.

A similar interpretation of cerebral functioning in schizophrenics was made by Gur (1978) and Schweitzer (1979) who found a greater percentage of right-moving CLEMS among schizophrenic subjects as compared to normal controls. A large literature has accumulated in which right CLEMS have been shown to reflect left hemisphere activation, while left CLEMS represent greater arousal of the right cerebral hemisphere (Lenhart, 1985). Typically, normal subjects move their eyes to the left or right depending on the cognitive and emotional nature of problems; schizophrenics have been shown to display a preference for right-looking regardless of the content of the question, thereby indicating left hemisphere hyperarousal.

The purpose of this study is to demonstrate convergence between these two research strategies in a schizotypal sample. Asymptomatic, never-hospitalized subjects were selected on the basis of their scores on several schizotypy scales. These subjects were then assessed psychophysiologically. Electrodermal variables were recorded bilaterally during rest and a neutral tone habituation sequence, and CLEMS were observed in response to questions varying in their cognitive and emotional elements. Previous studies employing the schizotypy scales have successfully demonstrated psychophysiological deviances in identified schizotypes (Simons, 1981; Simons, 1982; Simons, MacMillian, & Ireland, 1982), although none of these focused on laterality effects.

Method

Subjects

Subjects were right-handed undergraduates who received course credit for their participation. They were selected from among 278 students who completed a form containing screening versions of four Schizotypy Scales (Physical Anhedonia, Perceptual Aberration, Intense Ambivalence, and Somatic Symptoms; Raulin, Van Slyck, & Rourke, 1984). Six males and seven females who scored at least 2 SD above the mean on at least one of the scales were assigned to the risk group. Control subjects, (8 males and 8 females) were randomly selected from those scoring below 1.5 SD above the mean on all of the scales.

Procedure

All subject testing was conducted by experimenters who were blind to the schizotypy scores and the subjects.

Electrodermal response. Subjects were seated in an anechoic chamber where skin conductance was measured between the thenar and hypothenar eminences of the palmar surface of both hands. Signals from the GRASS model 7D polygraph were fed into an A-to-D converter connected to the laboratory computer which collected all data. Tonic skin conductance levels (SCLS), sampled every 20 sec, were recorded during both a 7-minute pre-habituation and 3-minute post-habituation rest period. The tone habituation sequence consisted of 20 presentations of a 1000 Hz, 2 sec, 75 db tone, with randomly selected interstimulus intervals of 16, 19, 22 and 25 sec. Magnitude of skin conductance responses (SCRS) was defined as the greatest skin conductance, sampled every .2 sec, within 5 sec of response onset minus the skin conductance at response onset. These data were transformed to the square root of change in conductance.

Conjugate lateral eye movements. Stimuli to elicit CLEMS were four groups of 48 questions: verbal-neutral, verbal-emotional, spatial-neutral, and spatial-emotional derived from Schwartz, Davidson, and Maer (1975) with slight modification to ensure subjects could not begin formulation of responses prior to the final word.

Subjects faced the experimenter with a one-way mirror and a symmetrical visual field behind the experimenter. Lateral direction of the first CLEM occurring at the end of each item was recorded. Questions were presented in the same randomly-determined order to all subjects. Only CLEMS deviating from central fixation and with a lateral component were scored as valid. Judgments of eye movement validity and lateral direction were subjected to interrater reliability analysis. For ten subjects, selected randomly, a second experimenter scored CLEMS independently through the one-way mirror. The primary experimenter was unaware when reliability trials were run. Agreement percentage was 88 percent for determination of valid CLEMS and 91 percent for judgments of lateral direction.

Results

Electrodermal Recordings

SCL data were averaged to obtain overall means for each subject for both rest periods and both hands. An ANOVA with sex and risk group as between factors and hand and time interval as within variables was conducted on these data. No significant effects were noted. There was a nonsignificant trend for risk males to produce slightly higher left than right SCLS, a pattern opposite of that predicted. The other three groups displayed symmetrical SCLS.

Amplitudes of SCRS to neutral tones were averaged every four trials to yield five block intervals. An ANOVA, with two between factors (sex and group) and two within factors (hand and time interval) was performed. A highly significant interaction involving hand and vulnerability group was observed, F (1,25) = 29.00, p <.0001. Analysis of simple main effects revealed that the means of 3.55 and 1.24 for the left and right hands, respectively, of high-risk subjects differed significantly, F (1,25) = 42.33, p <.001. This pattern is precisely opposite to that predicted. These same means for control subjects were 2.37 and 2.68, respectively, and did not differ significantly. Finally, a main effect of time was observed, F (4,100) = 10.68, p <.0001, indicating that for all subjects habituation to tones occurred.

Eye Movements

Frequencies of right- and left-tending CLEMS were transformed using the formula R - L / R + L, where R and L represent the number of right and left CLEMS occurring during each question category for each group. These proportions were analyzed with an ANOVA involving two between factors: sex and risk group, and two within variables: cognitive type (verbal and spatial) and emotional content (neutral and emotional). There were no significant effects involving the group variables.

Discussion

In this study, prepsychotic schizotypes produced significantly larger left than right hand SCR amplitudes to a neutral tone sequence. During rest periods tonic SCLS for males only followed a similar, though nonsignificant, asymmetrical pattern. These findings are the direct converse to those found in original studies of full-syndromal schizophrenics (Gruzelier, 1973; Gruzelier & Venables, 1974).

Several plausible explanations for this divergence exist. First, perhaps these findings reflect inherent problems with the hypothesis of left hemisphere abnormality in schizophrenia. This seems unlikely, however, given the growing literature supporting this notion (Newlin, Carpenter, & Golden, 1981). There is the additional issue regarding the lack of consensus with respect to cortical mediation of electrodermal activity and hence the meaning of any observed asymmetries (Boyd & Maltzman, 1984; Fedora & Schopflocher, 1984). Second, the Schizotypy Scales might not be specific to schizophrenic disorders. Previous research has shown strong associations between scores on these scales and those on the General Behavior Inventory (GBI), a psychometric device for detecting predisposition to bipolar depressive disorder (Lenhart, 1983). Moreover, using the GBI in an earlier study, Lenhart & Katkin (1986) demonstrated asymmetrical patterns of electrodermal activity in subsyndromal, high-risk for depression subjects identical to those obtained herein. Therefore, it is possible that these two self-report measures select samples which are similar -- at least psychophysiologically. A third possibility is that some form of subsyndromal affective disorder precedes full-blown schizophrenia and is reflected in the electrodermal asymmetries observed.

However, the most likely explanation includes elements of the preceding ones. Recently, Gruzelier (1981; 1983) has argued for dynamic process asymmetries, of which electrodermal activity and CLEM measures are examples, in both directions in schizophrenia. Asymmetries of left hemisphere hyperexcitability are accompanied by acute, florid, reactive, hypomanic, and paranoid symptoms (positive symptoms). Right hemisphere overactivation, which is associated with relatively greater left hand electrodermal activity, coincides with withdrawn, chronic, retarded, and nonparanoid behavior (negative symptoms) related to the classical schizophrenia of Kraepelin and Bleuler. Thus, it seems entirely possible that the schizotypy scales identify proneness to a particular subtype of schizophrenia, one which has affinities with the more classical features of schizophrenia and which may be characterized by right hemisphere hyperarousal, which can be measured as EDA asymmetries. It is certain that further research is required to clarify this issue.

A final note is made regarding the failure of CLEM data to differentiate risk and control groups in this experiment. Although this methodology has been shown to be potentially significant for the identification

of subjects vulnerable to primary affective disorder (Lenhart & Katkin, 1986), the present study suggests it may be of limited usefulness in selecting prepsychotic schizotypal subjects.

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