BILATERAL ELECTRODERMAL ACTIVITY AND PSYCHOTICISM:
EPQ-R P SCORE CORRELATES WITH SCL AND EEG ASYMMETRY *

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Summary

Several clinical studies have reported that schizophrenics show higher electrodermal activity (SCL and SCR) on their right compared to their left hand (R>L). According to Eysenck’s personality model, schizophrenia is located at the extreme pole of the psychoticism dimension (P). Thus, it could be hypothesized that normal Ss with high P scores will also show a R>L pattern, especially in comparison to Ss with low P scores.

Reported are the results of two studies in which healthy female Ss were given the Eysenck Personality Questionnaire (EPQ-R) before viewing emotionally charging and neutral stimuli in a visual half-field paradigm. Phasic and tonic electrodermal parameters were recorded from the palmar surface (study I) and medial phalanges (study II) of both hands. In addition, study II recorded continuously CNS activity (11 EEG leads). In study I, Ss with high P scores showed increased electrodermal activity on the right compared to the left hand (R>L). Ss with low P scores tended to show increased activity on their left hand (L>R). In study II, SCL hand differences (R-L) were significantly correlated with P scores and with EEG alpha asymmetry, i.e. relative larger right hand levels were associated with higher P scores and with relative more left frontal and temporal activation. Higher P scores were also significantly associated with relative left hemispheric activation in frontal, temporal and parietal regions.

The present results suggest a relationship between EDA asymmetry, asymmetric hemispheric activation and psychoticism score. High P scorers show similar asymmetrical EDA (R>L) and EEG (LH>RH) patterns observed in some types of schizophrenia. Concerning hypotheses about an asymmetrical hemispheric influence on bilateral electrodermal activity the results strongly support models of contralateral excitatory or ipsilateral inhibitory cortical control.

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Introduction

Considerable amounts of research have investigated the notion that abnormalities in hemispheric function may be related to a psychotic symptomatology. In reviewing the literature, Walker & McGuire (1982) favour a concept of left-hemispheric overactivation/dysfunction in schizophrenia, which is supported by both cognitive and physiological sources of hemispheric activation. On the other hand, several authors have considered the possibility that the broad psychoticism dimension of personality may be associated with individual differences in cerebral laterality (Rawlings & Borge, 1987).

For autonomic variables, an asymmetrical pattern of electrodermal activity (EDA) was reported for schizophrenic responders showing a higher activity on their right compared to their left hand (R>L) for both tonic and phasic parameters (e.g. reviewed by Flor-Henry, 1993). According to Eysenck’s model of personality in which schizophrenia depicts the extreme pole of the psychoticism (P) dimension it could be hypothesized that normals with a high markedness of P would exhibit a comparable asymmetrical EDA pattern (R>L).

Still under debate in which way cortical activity is related to electrodermal activity, asymmetry between both hands is expected to reflect an asymmetry in hemispheric functioning (Hugdahl, 1984). If a concept of left-hemispheric overactivation is valid for schizophrenic Ss, an EEG pattern with greater left than right hemispheric activation (LH>RH) could be postulated for Ss showing relative more electrodermal activity on their right hand (R>L).

Study I

Data from a previous study (Kayser & Erdmann, 1993) were reanalysed. In this study we investigated electrodermal activity in a visual half field paradigm in order to test 1) the hypothesis of a right hemispheric (RH) advantage in emotional processing, and, 2) hypotheses concerning possible asymmetrical influences on bilateral electrodermal activity (excitatory vs. inhibitory and ipsilateral vs. contralateral respectively). According to the present objective, two main goals of this study will be disregarded, i.e. questions referring to the lateralization of emotion and to the influence of different hemispheric strategies.
Method

Subjects: N=32, female students, age 19-33 years (MD=24), right-handed, divided into Ss with high and low P scores of the Eysenck Personality Questionnaire (EPQ-R, median split)

Stimuli: 32 slides of patients with dermatological diseases consisting of 16 negative/neutral pairs, exposed to each visual field (64 trials) in a block-randomized sequence in variable time intervals (15-21 s)

Registration: EDA: digitized at 40 Hz from the palmar surface (thenar and hypothenar) of each hand, two identical SC couplers (Coulbourn, 0.5 V constant-voltage), randomly shifted between Ss for left vs. right hand recordings

Scoring: SCL: noted before and after each of two trial blocks specific phasic SCRs: > 0.025 μS, 1-5 s after stimulus onset, magnitude measures by calculating the square root of the largest response

Results

SCL: Data were subjected to an ANOVA for two within-subject variables (recording time and response hand) and two between-subject factors (psychoticism score and instruction) which revealed a marginally significant interaction psychoticism score x response hand (F(1,28) = 3.62, p = .07) with high P scorers showing a higher level on their right hand (R>L, cf. Fig. 1).
**SCR**: Data of two phasic parameters (*response frequency* and *response intensity*) were subjected to separate ANOVAs for three within-subject variables (*hemisphere*, *stimulus quality* and *response hand*) and two between-subject factors (*psychoticism group* and *instruction*) which revealed a significant interaction *psychoticism x response hand* for SCR magnitude measures ($F(1,28) = 4.21, p = .05$) but missed a marginal significance for *response frequency* ($F(1,28) = 2.75, p = .11$). Separate ANOVAs for both psychoticism groups revealed for high P scorers significant more and larger specific SCRs on their right compared to their left hand (R>L, cf. Fig. 2).

**Study II**

In a follow-up study, data were recorded while Ss were at rest with eyes closed in a 2-min baseline period.

**Method**

- **Subjects**: N=25, female students, age 19-26 years ($MD=22$), right-handed, psychoticism score derived from a Norwegian translation of the *Eysenck Personality Questionnaire* (EPQ-R)

- **Registration**: **EDA**: digitized at 200 Hz from the medial phalanges (fore and middle fingers) of each hand, two identical SC couplers (*Thought Technology*, 0.5 V constant-voltage), randomly shifted between Ss for left vs. right hand recordings
EEG: digitized at 200 Hz from 11 standard derivations (10-20-system: Fz, Cz, Pz, F3, F4, T3, T4, P3, P4, O1, O2, one EOG channel, referenced to linked ears), GRASS amplification system

Scoring: SCL: averaged continuous recordings
*alpha (8-13 Hz) power* density ($\mu$V$^2$/Hz): Fast Fourier Transform (FFT), applied to artifact-free data chunks of 5.12 s (Hamming window, chunks overlapping by 75%), *lateralization ratio* ($L-R)/(L+R)$ for corresponding sites (correlation statistics), log$_{10}$-transformation (ANOVA statistics)

Results

Product-moment correlations were calculated between *psychoticism score, SCL asymmetry* (difference left - right hand) and *EEG asymmetry* (lateralization ratio for frontal, temporal, parietal and occipital sites) which revealed:

- a highly significant negative correlation between *psychoticism score* and *SCL asymmetry* ($r = -.52, p < .01$), i.e. higher $P$ scores associated with higher right hand levels (cf. Fig. 3)

- a highly significant negative correlation between *psychoticism score* and frontal *EEG asymmetry* ($r = -.58, p < .001$), and significant negative correlations between *psychoticism score* and temporal *EEG asymmetry* ($r = -.40, p = .02$) and parietal *EEG asymmetry* ($r = -.36, p < .05$) respectively, all indicating higher $P$ scores being associated with relative more left hemispheric activation (cf. Fig. 4)
Fig. 4 Correlations between EEG asymmetry (from top left to bottom right frontal, temporal, parietal, occipital) and psychoticism score.
Fig. 5 Correlations between EEG asymmetry (from top left to right bottom frontal, temporal, parietal, occipital) and SCL asymmetry.
- a highly significant correlation between SCL asymmetry and frontal EEG asymmetry \( (r=.47, p<.01) \), and a significant correlation between SCL asymmetry and temporal EEG asymmetry \( (r=.39, p<.05) \), both indicating larger right hand levels (L<R) being associated with relative more left hemispheric activation (cf. Fig. 5).

According to Ss P scores, the sample (N=25) was grouped into low (n=7), medium (n=10), and high (n=8) P scorers (cf. Fig. 6).

SCL data and log_{10}-transformed EEG data for each hemispheric site (frontal, temporal, parietal, occipital) were subjected to separate ANOVAs with psychoticism score as a grouping factor and response hand or hemisphere as a respective within-subject factor which revealed:

- a significant interaction psychoticism score \( \times \) response hand \( (F(2,22) = 4.69, p = .02) \), with significant hand differences for high P scorers (R>L, simple main effects, cf. Fig. 7)

- two significant interactions psychoticism score \( \times \) hemisphere at frontal \( (F(2,22) = 6.99, p<.01) \) and temporal \( (F(2,22) = 5.17, p = .01) \) sites, and a marginally significant interaction at parietal \( (F(2,22) = 2.92, p = .07) \) sites (cf. Fig. 8, showing significant hemispheric differences as simple main effects)

Fig. 6 Grouped sample (N=25).

Fig. 7 SCL means split by response hand and psychoticism group (significant simple main effects for hemisphere are marked).
**Fig. 8** Mean log$_{10}$-transformed alpha (8-13 Hz) power (μV$^2$/Hz) for different hemispheric sites (from top left to right bottom frontal, temporal, parietal, occipital), split by hemisphere and psychoticism score (significant simple main effects for hemisphere are marked).
Conclusions

1) For tonic and phasic electrodermal activity measures the hypothesized interaction *psychoticism score x response hand* was confirmed, i.e. Ss with high *P* scores exhibit a similar asymmetrical EDA pattern R>L which has been reported for schizophrenic responders.

2) Analogous to the concept of a left-hemispheric overactivation/dysfunction in schizophrenia, and in accordance with reported data, a pronounced left-hemispheric activation (LH>RH) was found for high *P* scorers. For the issue of asymmetrical cortical influences on bilateral electrodermal activity (e.g. Hugdahl, 1984) this result favours hypotheses suggesting a *contralateral-excitatory* or *ipsilateral-inhibitory* relation respectively.

3) Still under discussion what is reflected by the *psychoticism* dimension as assessed by questionnaire responses, the present results could be considered to support a tentative interpretation postulating a relationship between mild nonpsychiatric ‘schizotypic’ manifestations, asymmetric hemispheric activation (cf. Rawlings & Borge, 1987), and asymmetrical electrodermal activity. An asymmetrical cortical arousal, especially in frontal regions, might be the clue to an association of *electrodermal asymmetry* and *psychoticism score* in reflecting individual differences.

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References


