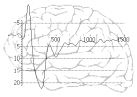
No association between anterior EEG trait asymmetry and affective style



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Introduction

The model of anterior asymmetry and emotion (AAE, Davidson, 1998) suggests that the left frontal lobe is part of an approach system and that the right frontal lobe is part of a withdrawal system. In addition, a trait-like asymmetry of baseline activation of these systems is supposed to be a diathesis for the experience of emotions: A person with greater left-sided activation of the frontal cortex might be characterized by a greater positive affectivity, whereas a person with greater right-sided activation might be characterized by a greater negative affectivity.

This association between frontal asymmetry and affective style has been examined in several studies. In the typical investigation, a resting EEG is recorded and the difference of the alpha activity (8-13 Hz) of contralateral homologous electrodes serves as a measure of frontal activation asymmetry. Affective style is assessed with an experimental measurement procedure or with questionnaires, and the association between asymmetry and affective style is analyzed with correlation statistics. However, the resulting evidence appears to be inconsistent and allows no unambiguous evaluation of the model.

Several recent studies allowed the identification of methodological factors that may contribute to this inconsistency:

(1) The recording of the EEG for less than 4 minutes may lead to unreliable asymmetry measures (Hagemann et al., 1998).
(2) Ocular artifacts may distort the mean asymmetry measure (Hagemann & Naumann, 2001).
(3) The usual EEG reference sites (common vertex reference, linked ears, average reference) show substantial activity in the alpha band und thus may distort the asymmetry measures (Hagemann et al., 2001).
(4) Only about 60% of the variance of the asymmetry measures reflect a stabile and consistent latent trait, whereas 40% of the variance of the measures are due to fluctuations that are specific for the measurement occasion (Hagemann et al., 2002).

The aim of the present study was the examination of the AAE whilst these methodological factors are considered.

Methods

Subjects	59 right-handed students 30 women (mean age 23 years, SD 3.4) 29 men (mean age 25 years, SD 3.2)
Procedure	4 occasions of measurement with one-month intervals. On each occasion: (1) Registration of resting EEG. (2) Measurement of affective style with experimental procedure involving affective films and slides, and with questionnaires.
EEG recording	12 one-minute resting baselines (6 eyes open and 6 eyes closed, counterbalanced orders). 32 tin electrodes of the 10-10 system, reference Cz. AC-recording, pass band 0.3 – 40 Hz, AD 200 Hz.
EEG quantification	Rejection of data portions with artifacts (43 – 49 % of all epochs). Transformation into measures of current source density (CSD), distance-weighted approach (r = 10 cm; Hjorth, 1980). Transformation into A1+A2 reference. Fast Fourier transformation of epochs (T = 2.56 s). Extraction of mean alpha power density (8 – 13 Hz). Normalization of the data by ln-transformation. Asymmetry measures: ln alpha R – ln alpha L Reduction of state fluctuation by aggregation of the measures across all 4 occasions (estimated trait specificity of the aggregates > .80; Hagemann et al., 2002).
Films	8 short films for the induction of emotions (Tomarken et al., 1990). Target emotions: 2 stimuli for each of happiness, disgust, anger, sadness. Presentation time: 30 – 129 s.
Pictures	30 pictures of the International Affective Picture System (IAPS, Lang et al. 1988) 15 with positive valence, 15 with negative valence Presentation time: each 6 s.
Affect ratings	0-9 rating scales for positive affects (happy, glad, jolly). 0-9 rating scales for negative affects (sad, afraid, angry, disgusted).
Experimental procedure	Presentation of all stimuli in restricted randomized order. Assessment of experienced emotions after each stimulus presentation with affect ratings.
Quantification of affective reactivity	Quantification separately for films and pictures. Global rating index (GRI) = mean across all affect ratings of all stimuli. Residualization of each affect rating AR (AR = b GRI + AR_{res}). Positive affect = mean of residualized positive affect ratings after presentation of positive stimuli. Negative affect = mean of residualized negative affect ratings after presentation of negative stimuli.
Questionnaires	PANAS (Watson et al, 1988) STAI-Trait (Spielberger et al., 1980)

Results

A correlation analysis of asymmetry (CSD) and affective style measures revealed no significant association between anterior asymmetry and emotion (table 1). However, there were associations between greater right-sided posterior cortical activation and negative affectivity.

Table 1: Correlations between measures of asymmetry and affective style, CSD data

Region	Positive Affect PA			Negative Affect NA			
	PA-NAS	Films	IAPS	PA-NAS	Films	IAPS	STAI
frontopolar	-.17	.02	-.02	.17	-.11	.00	.10
lateral frontal	.06	-.07	-.16	-.02	-.19	-.08	-.15
midfrontal	-.15	.03	-.08	-.23	-.07	-.01	-.22
anterior temporal	.09	.05	.08	-.07	-.17	-.15	-.18
central	-.01	-.14	-.14	.04	-.14	.05	.03
posterior temporal	.05	.10	.14	-.29*	-.15	-.10	-.28*
parietal	-.13	-.01	.02	-.15	-.27*	-.25	-.15
occipital	.07	-.08	-.11	.06	.00	-.01	.06

* p < .05 (two-tailed)

A parallel analysis of asymmetry (A1+A2) and affective style measures revealed an association between greater right-sided anterior temporal activation and negative affective reactivity to films consistent with the AAE (table 2). However, there were also relations between right-sided activation and positive reactivity to films, and a relation between right-sided posterior activation and negative reactivity to films.

Table 2: Correlations between measures of asymmetry and affective style, A1+A2 reference

Region	Positive Affect PA			Negative Affect NA			
	PA-NAS	Films	IAPS	PA-NAS	Films	IAPS	STAI
frontopolar	-.09	-.26*	-.10	-.02	-.18	.03	.03
lateral frontal	-.07	-.14	-.08	.13	-.21	.01	.12
midfrontal	-.03	-.10	.01	-.05	-.19	-.01	-.01
anterior temporal	-.04	-.17	-.11	.12	-.33*	-.14	.06
central	-.13	-.29*	-.14	.09	-.14	-.06	.12
posterior temporal	-.02	.03	.08	-.23	-.30	-.17	-.19
parietal	-.13	-.07	.01	-.11	-.31*	-.23	-.10
occipital	.04	-.10	-.09	.04	-.16	-.11	.03

* p < .05 (two-tailed)

Discussion

The data does not support the AAE: There was no consistent association between anterior asymmetry and affective style. However, there was an association between right-sided posterior cortical activation and negative affectivity, which was not predicted by the AAE.

Literature

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