Patterns of State and Trait Regional Brain Activity in Depression
Support the Capability Model of EEG Asymmetry

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Resting frontal electroencephalographic (EEG) asymmetry is a promising marker of risk for major depressive disorder (MDD) and propensities to engage in less approach- than withdrawal-motivated behaviors across situations. The capability model of individual differences in EEG asymmetry (Coan, Allen, & McKnight, 2006) suggests, however, that brain activity during emotional challenge will provide a stronger index of the capacity for depressed individuals to engage in approach and withdrawal responses when emotion regulation may be needed. Frontal EEG asymmetry during rest and emotional challenge of approach (anger, happiness) and withdrawal (fear, sadness) was assessed on 4 occasions in 203 individuals age 18-34 (31% male) with (n = 93) and without (n = 110) a diagnosis of lifetime MDD (MDD+ and MDD-).

Although results for men were not entirely consistent, findings for women were very clear: MDD+ women exhibited greater relative right frontal activity (lower right frontal alpha power) than MDD- women across conditions. Importantly, EEG asymmetry during the emotional challenge task was a more powerful indicator of lifetime MDD status than resting asymmetry in women, evidence in support of the capability model. Additionally, MDD+ women displayed lower bilateral alpha power during the emotional challenge conditions than MDD- women, indicating that different mechanisms may underlie patterns of state and trait asymmetry as a function of lifetime MDD status in women.

Introduction

Dispositional Model of EEG Asymmetry:
Frontal EEG asymmetry at rest is thought to reflect individual differences in dispositional style, or a general tendency to engage in approach or withdrawal motivation or behaviors. For example, less left than right resting frontal EEG activity (e.g., Allen et al., 2004b) may reflect reduced approach motivation and sensitivity to reward that may tip a diathesis toward the development of depression (Davidson et al., 2003). However, this relationship is typically of a small to medium effect size, and with methodological differences across laboratories influencing results (e.g., Allen et al., 2004a; Davidson, 1998; Hagemann, 2004).

Capability Model of EEG Asymmetry:
Individual differences in depression should be more powerful during approach and withdrawal emotional challenges than at rest, potentially powerful enough to reduce the influence of methodological differences across labs (Coan et al., 2006).

Hypotheses

1) MDD+ participants will display lower relative left frontal activity than MDD- participants across approach, withdrawal, and rest conditions.

2) EEG asymmetry during approach and withdrawal conditions, however, will demonstrate larger differences between MDD+ and MDD- groups than EEG asymmetry at rest, consistent with the capability model of individual differences.

3) EMG activity (70-90 Hz) will not account for pattern of results.

Methods

203 Participants
93 (25 men) Lifetime MDD+
110 (42 men) Lifetime MDD-

8 minutes resting EEG

Directed Facial Action Task
(1 minute per facial expression)

8 minutes resting EEG

Each subject run 4 times within 2 weeks

Summary of EEG Asymmetry Scores

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<thead>
<tr>
<th>Condition</th>
<th>Dependent Variable</th>
<th>Between-Subjects</th>
<th>Within-Subjects</th>
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<td>Lifetime MDD+</td>
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<td>Approach</td>
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<td>Rest</td>
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<td>Rest</td>
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Data Collection, Reduction, and Analysis:
1K Hz sampling rate (bandpass 0-200 Hz) using online reference just posterior to Cz and then re-referenced offline to average reference (AVG) and averaged (‘Averaged’ left mastoid) (LM).

Data epoched into 117.2 048 s epochs per one-minute block, overlapping by 1.5 seconds, submitted to FFT

Asymmetry scores calculated by subtracting natural log transformed scores (i.e., Ln(Right) – Ln(Left)) for each homologous left and right frontal channel pair. Higher scores relative more left frontal activity, i.e., relatively less frontal alpha, if Allen et al., 2004a)

Asymmetry scores computed for both resting sessions and each facial expression (angry, sad, happy, and withdrawal) per channel pair

Results

EMG Residualization

Discussion

Results for women demonstrate that MDD+ was associated with less relative left frontal activity than MDD- across state emotion and trait resting sessions, consistent with hypotheses. Differences in frontal brain activity between MDD+ and MDD- women were stronger during approach and withdrawal state emotion than during rest, evidence in support of the capability model.

During the state emotion task, men and women showed similar patterns of asymmetry with respect to lifetime MDD, with less relative left frontal activity associated with MDD, consistent with hypotheses. At rest, however, sex-specific patterns emerged, with men showing the opposite relationship of frontal asymmetry to depression, findings consistent with a small literature on sex differences in depression and regional brain activity.

Although EMG activity did not account for the overall pattern of results, consistent with hypotheses, muscle movements did appear to account for MDD+ and MDD- differences for men during approach-related facial expressions, demonstrating that EMG can influence EEG asymmetry.

In summary, both state and trait frontal EEG asymmetry hold promise as a liability indicator for depression in women, although they may be indicators for different mechanisms, as evidenced by bilateral alpha power differences between state emotion and trait conditions.

References


