The Oft-Neglected Role of Parietal EEG Asymmetry and Risk for Major Depressive Disorder

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Abstract

Relatively less right parietal activity may reflect reduced arousal and signify risk for major depressive disorder (MDD). Inconsistent findings with parietal electroencephalographic (EEG) asymmetry, however, suggest issues such as anxiety comorbidity and sex differences have yet to be resolved.

Resting parietal EEG asymmetry was assessed in 306 individuals (31% male) with (n = 143) and without (n = 163) a DSM-IV diagnosis of lifetime MDD and no comorbid anxiety disorders.

Contrary to prediction, lifetime MDD+ men displayed relatively greater right parietal activity than lifetime MDD- men, whereas lifetime MDD+ and MDD- women did not differ.

To examine parietal asymmetry as a function of current depression status, the lifetime MDD+ group was then divided into current MDD+ versus past MDD+ groups. Past MDD+ women displayed relatively less right parietal activity than current MDD+ and MDD- women, replicating prior work and providing an explanation for the initial null lifetime MDD findings.

In addition, recent caffeine intake, an index of arousal, moderated the relationship between depression and EEG asymmetry for men and women. Current MDD+ and past MDD+ men exhibited relatively greater right parietal activity than MDD- men at high but not low levels of caffeine intake. Moreover, caffeine intake moderated asymmetry for current MDD+ women, such that higher caffeine intake was linked to higher relative right parietal activity.

Findings suggest that sex differences and arousal should be examined in studies of depression and regional brain activity.

Introduction

❑ Relatively lower right than left resting parietal electroencephalographic (EEG) activity may be a psychophysiological indicator for depression risk because it:

1. Distinguishes symptomatic and remitted depressed individuals from never-depressed individuals (e.g., Bruder et al., 1997; Kentgen et al., 2000)
2. Is prominent in family members of depressed patients (Bruder et al., 2005; Bruder et al., 2007)
3. Is linked with other indices of depression risk such as low positive emotionality (Shankman et al., 2005)

❑ Several resting EEG studies, however, have failed to confirm this association (e.g., Debener et al., 2000; Nitschke et al., 1999).

❑ Inconsistent results may be due to:

1. Small patient samples
2. Diagnostic heterogeneity (anxiety comorbidity)
3. Depression recruitment strategies (i.e., on the basis of a DSM-IV diagnoses versus questionnaires)
4. Sex differences in depression and/or EEG asymmetry (e.g., Miller et al., 2002; Stewart et al., 2010).

Questions

❑Does relatively lower right parietal activity at rest characterize both women and men with a lifetime diagnosis of MDD who are free of comorbid anxiety disorders?

❑Are lifetime MDD results due to a diagnosis of current MDD versus past MDD?

❑Since parietal EEG asymmetry is thought to reflect arousal-related processes, does an index of arousal (recent caffeine intake) moderate the relationship between parietal EEG asymmetry and depression in men and women?

Methods

❑ N = 306 strongly right-handed participants (73% Caucasian), age range 17 to 34 years (*M* = 19.1, *SE* = 0.1)

❑ Lifetime MDD+ group did not meet criteria for any DSM-IV Axis I disorder other than lifetime MDD and comorbid current dysthymia.

❑ Lifetime MDD- group did not meet criteria for any DSM-IV Axis I disorder.

❑ Recency of caffeine intake measured by question "When was the last time you consumed caffeine? 0 = I have not used any since my last visit, 1 = earlier this week, but not yesterday, 2 = yesterday before 5pm, 3 = yesterday evening after 5pm, 4 = today."

MDD Status	Group	Recency of Caffeine Intake
Lifetime MDD+ (n = 143)	Current MDD+	
	Men (n = 18)	2.5 (0.2)
	Women (n = 44)	2.2 (0.1)
	Past MDD+	
	Men (n = 20)	2.7 (0.3)
	Women (n = 55)	2.5 (0.2)
Lifetime MDD- (n = 163)	Men (n = 56)	2.5 (0.2)
	Women (n = 107)	2.2. (0.1)

❑ EEG session = Eight 1-minute periods of resting EEG (four minutes eyes open, four minutes eyes closed, counterbalanced)

❑ Two resting EEG sessions completed during each visit, on four separate days with no fewer then 24 hours between visits, with four visits completed within a 14 day period

❑ EEG data re-referenced to four reference montages: average of all EEG leads (AVG), current source density (CSD; Kayser & Tenke, 2006), Cz, and linked mastoids (LM)

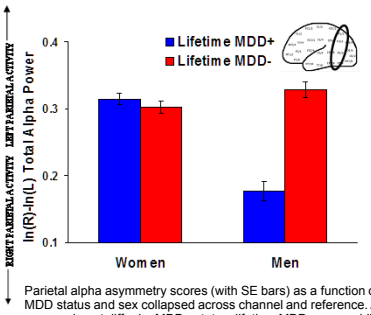
❑ Each minute of data epoched into 117 2.048 second-length epochs overlapping by 1.5 seconds, Hamming window applied, blink and artifact rejection performed, Fast Fourier Transform applied to all artifact-free epochs, and total alpha power (8-13 Hz) extracted

❑ Asymmetry score for each resting session calculated for each site by subtracting the natural log transformed scores (i.e., ln[Right] – ln[Left]) for each homologous left and right pair; scores for each session averaged to create robust trait measure of EEG asymmetry

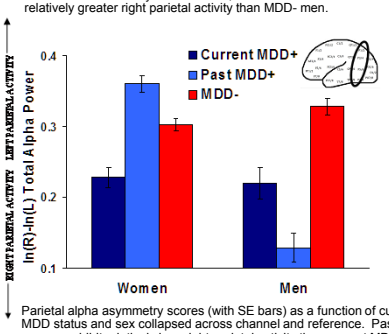
❑ Higher asymmetry score values thought to reflect relatively greater left than right parietal activity (i.e., relatively greater right than left alpha; cf. Allen, Coan, & Nazarian, 2004).

Mixed Model Analysis (SAS) Dependent Variable = Parietal Asymmetry score	
Between-Subjects	Group, Sex
Within-Subjects	Channel (P2-P1, P4-P3, P6-P5, P8-P7)
	Reference (AVG, CSD, Cz, LM)

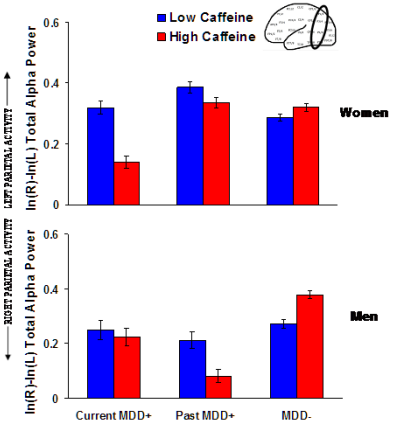
Results



Parietal alpha asymmetry scores (with SE bars) as a function of lifetime MDD status and sex collapsed across channel and reference. Although women do not differ by MDD+ status, lifetime MDD+ men exhibit relatively greater right parietal activity than MDD- men.



Parietal alpha asymmetry scores (with SE bars) as a function of current MDD status and sex collapsed across channel and reference. Past MDD+ women exhibit relatively less right parietal activity than current MDD+ women and MDD- women, whereas past MDD+ men display relatively greater right parietal activity than current MDD+ men and MDD- men.



Parietal alpha asymmetry scores (with SE bars) as a function of current MDD status and caffeine intake averaged across sessions (illustrated by plotting estimated means±1 standard deviation) for women (top panel) and men (lower panel) collapsed across channel and reference.

Current MDD+ women displayed greater relative right parietal activity than past MDD+ women and MDD- women at high levels of caffeine intake, whereas current MDD+ men and past MDD+ men exhibited relatively greater right parietal activity than MDD− men only at high levels of caffeine intake.

Discussion

❑Past MDD+ women displayed relatively less right parietal activity than MDD- women, a pattern of asymmetry consistent with other parietal EEG studies of depression (e.g., Bruder et al., 1997; Kentgen et al., 2000).

❑ Although current MDD+ women exhibited higher relative right parietal activity than past MDD+ women, this effect was partially moderated by arousal (caffeine intake), such that this effect was larger at high than low levels of recent caffeine consumption.

❑ Caffeine may affect arousal processes differently as a function of current MDD status to obfuscate the underlying risk pattern for MDD. Future work might utilize multiple measures of arousal sensitivity (such as anxious arousal) to explore this possibility.

❑Unlike lifetime MDD results for women, lifetime MDD+ men displayed higher relative right parietal activity than lifetime MDD- men, and this large effect size was replicated in analyses of current MDD+ and past MDD+ men, but this effect only held at high levels of caffeine intake.

❑ These results may explain, in part, null findings in parietal EEG asymmetry studies that did not examine sex differences in depression.

❑ Due to limited research on sex differences and EEG asymmetry in individuals with MDD (thus far, only in frontal regions: Stewart et al., 2010; Miller et al., 2002), further examination is needed to evaluate the significance of parietal asymmetry in men.

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