Where it’s at: Estimating sources of frontal EEG alpha asymmetry

Ezra E Smith¹, James F Cavanagh², and John JB Allen¹
¹University of Arizona; ²University of New Mexico

Summary

Alpha activity in the dLPCF, insula, pre- and post-central gyri, and medial PFC, contributes to surface alpha asymmetry and depression risk.

Background

Frontal EEG alpha asymmetry is related to emotional styles and risk for depression. However, only a handful of PET and fMRI studies have investigated asymmetry across the frontal lobes, and the regions which give rise to frontal EEG alpha asymmetry and depression risk are not well understood.

Method

N=306
8 EEG sessions
143 MDD+
163 MDD-

(1) Collect and process data

(2) Calculate surface asymmetry
Right sites – Left sites

(3) sLORETA source estimates

(4) Calculate source asymmetry by subtracting R-L Brodmann’s

Results and Discussion

- Brain regions related to surface asymmetry and to less left-than-right activity in MDD+
  - Postcentral gyrus (BA 1,2,3)
  - Insula (BA 13)
  - Precentral gyrus (BA 4)
  - Dorsal cingulate (BA 24)
  - Angular gyrus (BA 23)

- Less relative left dLPCF activity in MDD+
  - Less relative left dLPCF activity may indicate reduced approach-oriented cognitive control strategies in MDD+ participants.

- Insula contributes substantially to surface asymmetry (rs>.6)
  - Insula activity has not been previously linked to frontal EEG alpha asymmetry, although it has been linked to depression and anxiety in resting-state fMRI reports.

- Altered processing of autonomic input in MDD+
  - The left insula receives predominantly parasympathetic afferents, whereas the right insula receives mostly sympathetic afferents. Less relative left insula activity in MDD+ participants may indicate a relative insensitivity to parasympathetic afferents in MDD. This is consistent with our recent work finding decreased BOLD-RSA coupling in the left anterior insula in MDD, and that this BOLD-RSA coupling increases with successful antidepressant treatment.

- Tonic sensory-motor activity may reveal vulnerability for (or consequence of) low approach motivation and MDD risk
  - Less relative left activity in the medial PFC in strongly right-handed MDD+ participants may indicate diminished action-monitoring perhaps related to behavioral approach. Similarly, activity in the pre- and post-central gyri in a strongly right-handed sample could reflect a reduction in approach motivation in MDD+ participants.