# Frontal EEG Asymmetry in Highly Aggressive 5-6 Year-Old Girls

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## Background

Physical aggression in children often remains stable and is indicative of risk for on-going behavioural problems and externalizing disorders over the lifespan. Subjective emotional responses differ across gender and antisocial behaviour patterns, suggesting boys and girls may differ in risk factors for aggressive behavior.[1] Emotional experience, mediated by approach- and withdrawal-related motivational systems, have been associated with distinct patterns of electrocortical activity,[2] with approach emotions (e.g., happiness, anger) associated with greater relative left frontal (LF) activity and withdrawal emotions (e.g., fear, sadness) associated with greater relative right frontal (RF) activity. Parietal activity is thought to moderate arousal levels of emotion. The Valence/Arousal model proposes that increased and decreased activity in the right parietal region predicts risk for anxiety and depression, respectively.[3]

**Research Question:** Do highly aggressive 5 and 6-year-old girls and boys differ from controls on frontal and parietal EEG activity during resting conditions and during the viewing of emotion-evoking film clips?

***Hypothesis :*** Aggressive children will show greater left frontal activity during baseline and during the experience of videos that elicit approach-related emotion, and reduced right frontal activity during the experience of withdrawal-related emotion.

## Method

**Participants:**

- 45 girls (18 identified as high on aggression, 27 controls)
- 37 boys (22 identified as high on aggression, 15 controls)
- Kindergarteners (5-6y) from a high risk urban neighborhood
- Ethnicity:
  *Girls:* 58.7 % African American, 8.7 % Caucasian, 30.4 % Hispanic, 2.2 % Asian
  *Boys:* 77.8 % African American, 2.8 % Caucasian, 16.7% Hispanic, 2.8 % Asian

**Experimental conditions:**

- EEG was collected during resting conditions and while viewing 4 emotionally-evoking film clips (fear, sad, happy, angry) for 90-180 s each, separated by a 30 s neutral film segment and 30 s of fixation screen.
- Baseline: 2-minutes eyes-open resting condition while subjects viewed Windows XP starfield screensaver.

**Electrophysiological measurements:**

- 32 channels, Biosemi system, 512 points/sec
- Alpha (7-12 Hz) scored by FFT
- Frontal sites: F3, F4; Parietal sites: P3, P4
- Minimum 30 seconds artifact-free data per emotion

## Results

***1. Do aggressive and non-aggressive children differ in electrocortical asymmetry across conditions?***

### *Frontal Regions*

**Primary effects:** **Girls:** Trend for Condition x Hemisphere x Group interaction $F(4, 172) = 2.23$, $p = .07$ (see **Figure 1**). **Boys:** No significant effects were found for boys ($F(4,140) < 1$, ns).

For Girls, breaking this down by emotion x baseline, Happy was significant ($F(1, 43) = 7.50$, $p = .009$): The High Risk group showed increased activity in LF and RF* to the happy video clip compared to baseline, whereas the Low Risk group showed increased cortical activity in LF and a reduction of cortical activity in RF. No significant effects were found for Fear, Sad, and Angry (all $F(1, 43) < 1$, ns) conditions.

### *Parietal Regions*

**Primary effects:** **Girls:** Cond x Hemis x Group interaction: $F(4, 172) = 3.187$, $p = .017$ (see **Figure 2**). **Boys:** No significant effects ($F(4,140) < 1$).

For Girls, breaking this down by emotion x baseline, Sad and Angry were significant ($F(1, 43) = 5.11$, $p = .029$; $F(1, 43) = 6.36$, $p = .015$). Happy and Fear were not significant ($F(1, 43) < 1$, ns, ($F(1, 43) = 1.50$, ns, respectively). In the High Risk group, there was a reduction in alpha for all emotions at P4 compared to P3 that reached significance for Angry and Sad conditions.

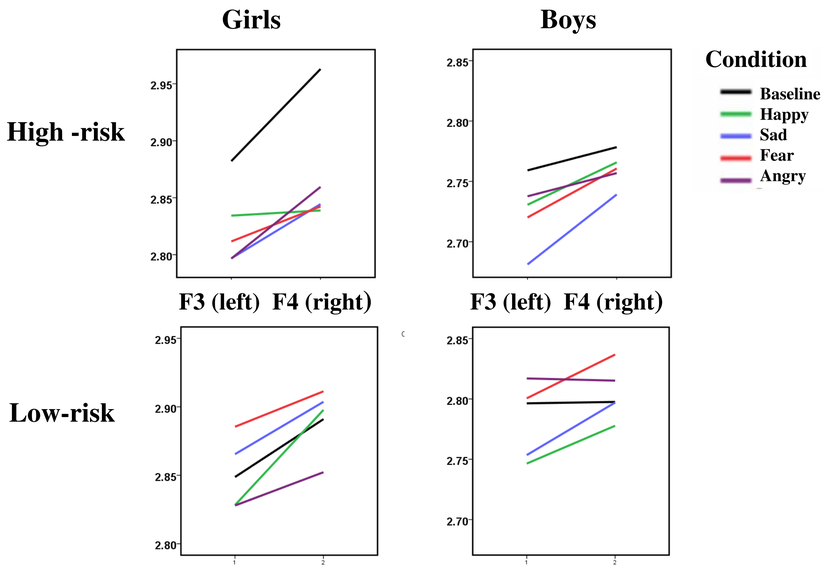


**Figure 1.** Average ln alpha power ($\mu V^2$) for Frontal sites for High Risk and Low Risk Groups for both Girls and Boys

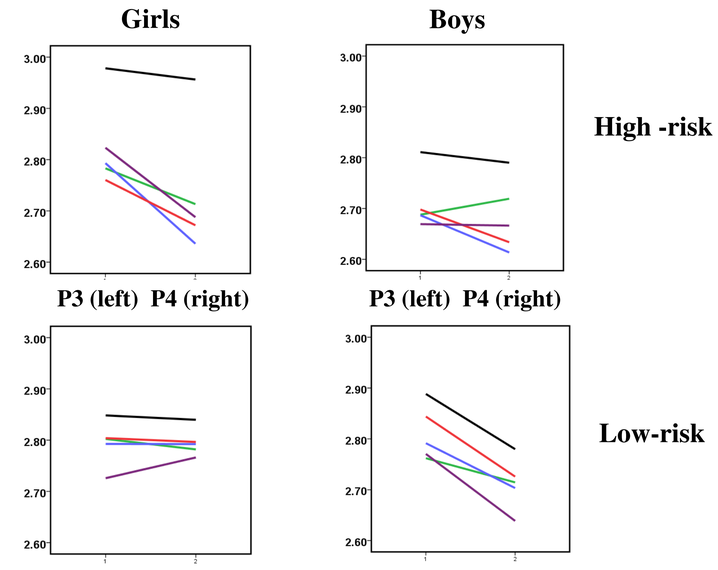


**Figure 2.** Average ln alpha power ($\mu V2$) for P3/P4 for High Risk and Low Risk, Girls and Boys

*Note:Alpha power is inversely related to cortical activity (greater alpha power = reduced cortical activity; reduced alpha power = greater cortical activity).

## Conclusions

In this preliminary study, we found that

1) Young girls' risk level for aggressive behaviour may be manifested electrophysiologically first in responses to pleasant emotion. Aggressive girls showed atypical symmetrical activity in response to the happy condition, while controls showed greater left frontal activation as predicted by the approach/ withdrawal model of emotion.[2]
2) There are gender-specific differences in electrophysiological responses to emotion for aggressive children and non-aggressive controls. Studies investigating aggressive behavior in children should take gender into account when designing studies.
3) Increased right parietal activity in response to emotions in aggressive girls may reflect risk for comorbid anxiety disorder. Given that girls are at differential risk for certain comorbid conditions, identifying different physiological patterns early may help shed light on how these comorbid conditions develop differently over time.

## References

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