

# Heterogeneity in Mu Rhythm Suppression in School-Aged Children with and without Autism Spectrum Disorder (ASD): Results from the ABC-CT Interim Analysis

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## Background

- Mu rhythm is oscillatory electroencephalogram (EEG) activity in the 8-13 Hz frequency range originating from the sensorimotor cortex
- Mu rhythm is suppressed during execution, imitation, or observation of motor actions, reflecting activity of the action observation network (AON)
- Mu suppression occurs in response to point-light displays of biological motion in typically developing (TD) adults
- Dysfunction in the AON may contribute to social difficulties in Autism Spectrum Disorder (ASD)
- Females display stronger mu suppression in response to biological motion
- Using mu suppression as an index of the AON has been criticized based on its weak effects and confounding with alpha suppression, which reflects attentional processing in response to visual stimuli

## Objectives

1. Distinguish mu suppression from global alpha activity
2. Assess mu activity in response to point-light biological motion and scrambled motion in school-aged children with and without ASD
3. Analyze relationships between mu suppression and ASD symptom severity

## Methods

### Participants

- Clinical and EEG data were collected from 160 children, 6 to 11 years of age, participating in the Autism Biomarkers Consortium for Clinical Trials (ABC-CT; Table 1)

### Cognitive & Behavioral Assessments

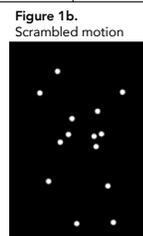
- ASD diagnoses were confirmed using the ADOS-2, ADI-R, and DSM-5
- Full-Scale IQ was measured using the DAS-II
- ASD symptom severity was measured using:
  - ADOS-2 calibrated severity score (CSS)
  - Social Responsiveness Scale (SRS-2)

**Table 1.** Participant demographic data. ASD and TD groups were matched on age ( $p>0.05$ ) but not on DAS-II, ADOS-2 CSS, or SRS-2 T-scores ( $p<0.05$ )

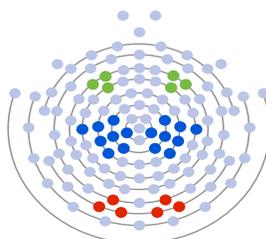
Group	N (Females)	Mean Age (SD)	DAS-II (SD)	ADOS-2 CSS (SD)	SRS-2 T-score (SD)
ASD	106 (23)	8.8 (1.6)	98.7 (17.7)	7.7 (2.0)	73.4 (10.5)
TD	55 (21)	8.6 (1.7)	114.6 (13.0)	1.5 (.7)	42.1 (3.5)

### Experimental Paradigm

- Point-light displays
  - Human walking (Figure 1a)
  - Scrambled motion (Figure 1b)
- 4 blocks of 26 trials in random sequence
- Trial structure
  - Fixation crosshair (1025-1200 ms)
  - Stimulus (1000 ms)



## Methods



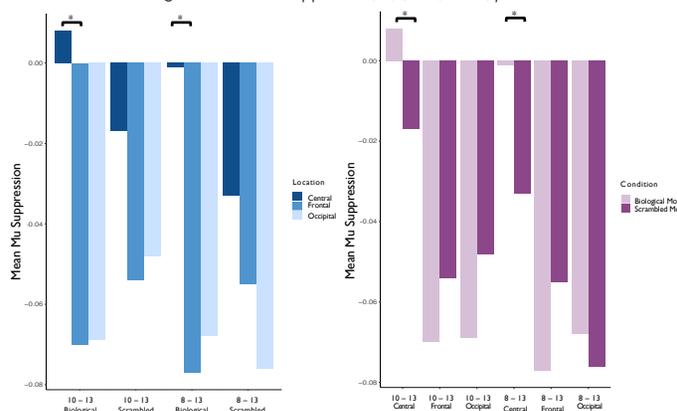
**Figure 2.** Frontal, central, and occipital electrodes

### Analysis Plan

- EEG collected using a 128-channel HydroCel Geodesic Sensor Net
- Mu suppression was analyzed using a within-trial baselining method
  - Mean log power during fixation crosshair minus mean log power during stimulus presentation
  - More positive values indicate higher levels of mu suppression
- Mu power was measured from central, frontal, and occipital electrode clusters over both hemispheres (Figure 2) and in frequency bands with distinct functional and topographic properties
  - Traditional mu (8-13 Hz)
  - Upper mu (10-13 Hz)
  - Lower mu (8-10 Hz)
  - Beta (13-30 Hz)

## Results

- Mixed-design ANOVA with condition (biological motion, scrambled motion) and location (central, frontal, occipital) as within-subject factors and sex (male, female) as between-subjects factor revealed condition by location interactions
  - 8-13 Hz biological motion mu suppression,  $F(2, 158)=3.20, p<0.05$
  - 10-13 Hz biological motion mu suppression,  $F(2, 158)=3.55, p<0.05$



**Figure 3a.** Simple main effects of location (central, frontal, occipital) for ASD and TD participants in response to biological motion and scrambled motion at 8-13 Hz and 10-13 Hz. \* =  $p<0.05$

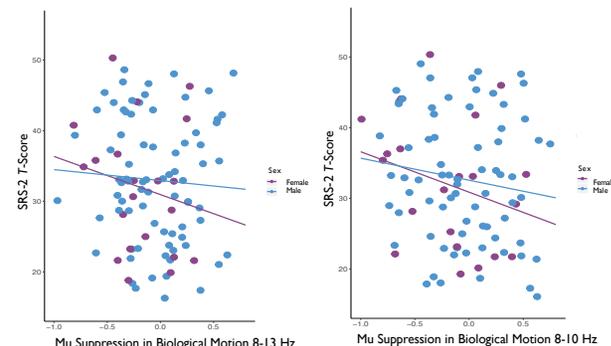
**Figure 3b.** Simple main effects of condition (biological motion, scrambled motion) for ASD and TD participants in response to central, frontal, and occipital scalp regions at 8-13 Hz and 10-13 Hz. \* =  $p<0.05$

## Results

- Figure 3a highlights that location effects were observed only in biological motion in both the 8-13 Hz and 10-13 Hz bands, indicating increased mu suppression over central leads relative to frontal and occipital leads
- Figure 3b shows that a significant increase in mu suppression in response to biological motion only occurred over central electrodes in the 8-13 Hz and 10-13 Hz bands

### Mu Suppression and Symptom Severity

- Mu suppression in the TD and ASD groups did not correlate with total SRS-2 scores or ADOS-2 scores
- In females with ASD, SRS-2 T-scores correlated with 8-13 Hz and 8-10 Hz components in the frontal region (Figure 4)



**Figure 4a.** Biological motion mu suppression 8-13 Hz and SRS-2 T-score. For ASD females:  $r=-0.50, p<0.05$ ; For ASD males:  $p>0.05$

**Figure 4b.** Biological motion mu suppression 8-10 Hz and SRS-2 T-score. For ASD females:  $r=-0.47, p<0.05$ ; For ASD males:  $p>0.05$

## Conclusions

- Traditional mu (8-13 Hz) suppression and upper mu (10-13 Hz) suppression were observed in response to biological motion over central scalp regions
- No group differences in mu suppression emerged between ASD and TD populations, adding to an inconsistent literature regarding mu suppression in ASD
- Sex differences were observed in the relationship between mu suppression and ASD symptomology
- Ongoing research examines effects of lateralization and alternate baselining techniques

