

EEG EVIDENCE FOR MIRROR NEURON DYSFUNCTION IN AUTISM

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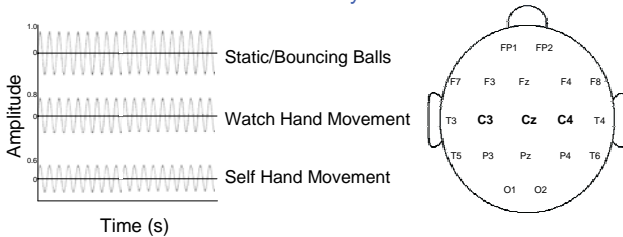


Introduction

Individuals with autism often display deficits in social and communicative skills, such as empathy, imitation, joint-attention, language, and “theory-of-mind”. Previous studies in our laboratory suggest that these deficits may be a result of either a dysfunctional fronto-limbic circuit or “mirror neuron” system^{1,2}. Mirror neurons, originally identified in motor planning areas of the frontal cortex, become active during self, imagined, and observed movement. Mirror neuron activity may underlie the ability to relate to others physically, mentally, and emotionally. Studies with typically developing individuals in both our laboratory and others indicate that suppression of EEG oscillations in the mu frequency band (8-13Hz) over prefrontal cortex is correlated with mirror neuron activity³⁻⁶.

The current study investigated the functioning of the mirror neuron system in high functioning individuals with Autism Spectrum Disorders (ASD) by analyzing mu wave suppression in response to videos of visual noise, bouncing balls, and a moving hand. Additionally, participants were asked to imitate the previously observed hand movement with their own hand. Individuals with ASD showed mu wave suppression to self-movement, but not to watching other’s movements, suggesting a dysfunction in the mirror neuron system.

EEG Analysis



At rest, pre-motor neurons spontaneously fire in synchrony⁷, leading to large amplitude EEG oscillations in the 8-13 Hz (mu) frequency band. When typically developing subjects watch an action performed, these neurons fire asynchronously, which decreases the amplitude of the mu-band EEG oscillations (mu wave suppression), this suppression is even greater when subjects perform the action³⁻⁵.

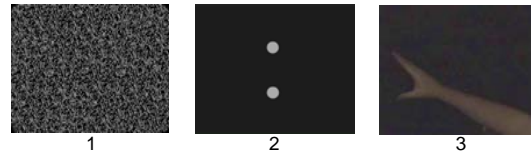
For each two-minute segment of data obtained per condition, the integrated power in the 8-13 Hz (mu frequency band) range was computed using the Neuroscan average function for scalp locations corresponding to premotor cortex (C3, Cz, and C4). Power during the bouncing balls, watching hand movement, and self hand movement tasks were compared to power during the baseline (visual white noise) condition. Mu wave suppression was calculated as the ratio of the power during experimental tasks to the power during the baseline condition. Since ratio data is inherently non-normal as a result of lower bounding, a log transform was used for analysis.

Task

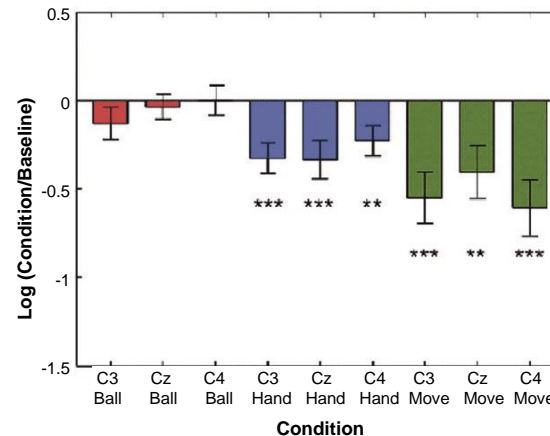
EEG data was collected during four conditions:

1. Watching visual white noise (Baseline).
2. Watching a video of two balls bouncing.
3. Watching a video of a moving hand.
4. Moving their own hand.

*To ensure that subjects attended to the stimuli during the watching hand movement and bouncing balls tasks, a continuous performance task was used. Periodically during these tasks, the stimuli stopped moving for a period of 1 second. Subjects were told to count the number of times stimuli stopped moving and report the number of stops to the experimenter at the end of the task.



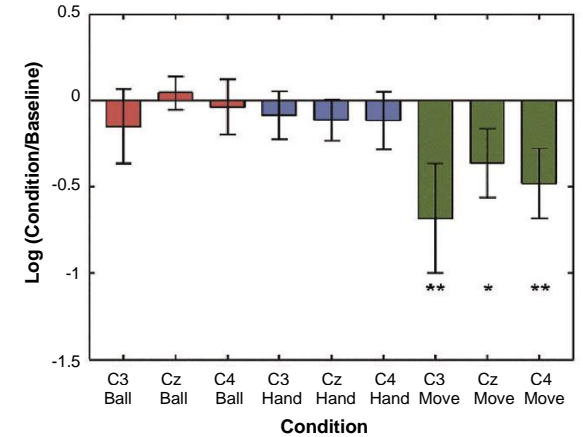
Control Results



*p < .05, ** p < .01, *** p < .005.

A log ratio of less than zero indicates suppression whereas a value of zero or greater indicates no suppression.

Autism Spectrum Disorders Results



Conclusions

1. Mu wave suppression reflects activity of the mirror neuron system.
2. As a group, high-functioning individuals with autism spectrum disorders (ASD) fail to show mu wave suppression to observed hand movement.
3. This impairment may contribute to many of the behavioural deficits observed in high-functioning individuals with ASD.

References

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