

Intelligence and Brain Dynamics in Children with Cerebral Palsy

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Introduction: Functional connectivity studies in children with cerebral palsy (CP) show tend to recruit more cortical regions, have longer global network path lengths, smaller P300 amplitude, decreased alpha power and decreased functional connectivity in the frontal lobe alpha band than typically developing (TD) children. These differences also are shown in children with lower cognitive function. However, only 50% of children with CP exhibit intellectual disability. This suggests different functional connectivity patterns may be associated with the neural substrate of cognitive ability of people with different neuropathology[1, 2].

Material, Methods and Results: Using our P300 BCI-adapted Pearson Peabody Picture Vocabulary Test (PPVT-IV) on 5 TD children (16 ± 3.6) and 5 age-matched children with CP (16 ± 4.6) [3], we collected electroencephalography (EEG) data and PPVT-IV results. PPVT-IV results were used as a proxy for intelligence and compared to the subject's brain dynamics: P300 amplitude, path lengths, alpha power and functional connectivity.

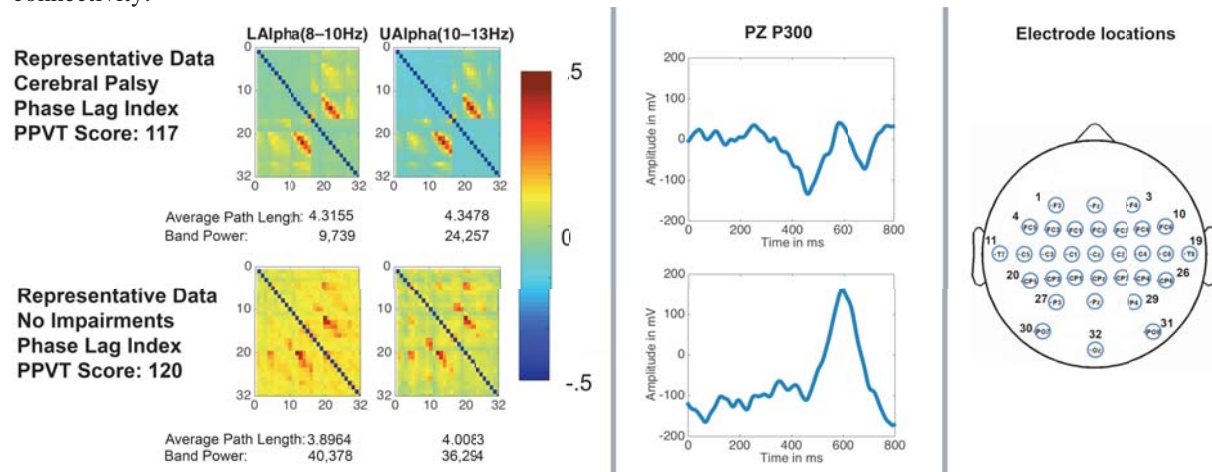


Figure 1. Representative data of a subject with CP and typically developing counter part. Left: Heat map of functional connectivity based on electrode connectivity. Center: Grand average P300 of Pz electrode. Right: Electrode montage used.

All CP subjects had lower connectivity in the frontal lobe alpha bands compared to age matched TD peers. We found no significant difference ($p = 0.26$) in path length (4.64 ± 0.18 for CP compared to 4.58 ± 0.40 for TD) or in PPVT test scores. The P300 amplitude at Pz was smaller for the CP group with a grand average of 109 ± 58 μV compared to 132 ± 65 μV . Using a spearman correlation PPVT-IV scores were not significantly correlated. However, both TD ($r = -0.47$) and CP ($r = -0.41$) lower alpha trended negatively.

Discussion: Our results suggest that previous finding relating functional connectivity to intelligence does not directly apply to children with cerebral palsy. Subjects with CP had lower connectivity in the frontal lobe alpha bands, alpha band power and P300 amplitude than typically developing children. However, they scored similarly to typically developing children on the PPVT, demonstrating that typical brain dynamics associated with intelligence do not apply. We believe this is due to the neural compensation resulting from the subject's pathology.

Conclusion and Significance: Our work demonstrates that further research is needed to understand the relationship in brain dynamics and intelligence in people with brain insults.

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