

Introduction

Attention-deficit/hyperactivity disorder (ADHD) and traumatic brain injury (TBI) are major public health problems that affect 3% or higher in adult population with ADHD and at least 1.7 million people with TBI in the U.S. Additionally, Neurobiological mechanisms associated with ADHD- and TBI-induced inattention are still unclear.

In this research, brain activities of ADHD, TBI, and normal control (NC) participants were measured in response to visual attention task to test for functional brain activation and connectivity pattern. Fifty-nine subjects participated: 20 in ADHD, 19 in NC, and 20 in TBI. The consent procedure was approved by the institutional review board (IRB) at NJIT, and written informed consent was obtained from each participant.

Methodology

The three groups were demographically balanced for age and gender, and regions of interest (ROIs) related to visual attention processing were selected (see **Figure 1**). Functional near-infrared spectroscopy (fNIRS) was used to measure oxygenated hemoglobin (HbO) changes in the ROIs (see **Figure 2**).

The measured light intensity change data from fNIRS were processed and mapped onto brain template to find significant brain activation (see **Figure 3**). To test between-ROI connectivities, Pearson correlation coefficient was used to determine the “connected-ness.” One-sample t-test, one-way ANOVA, and one-way ANCOVA were used to determine significant activation or connectivities within each group and between groups.

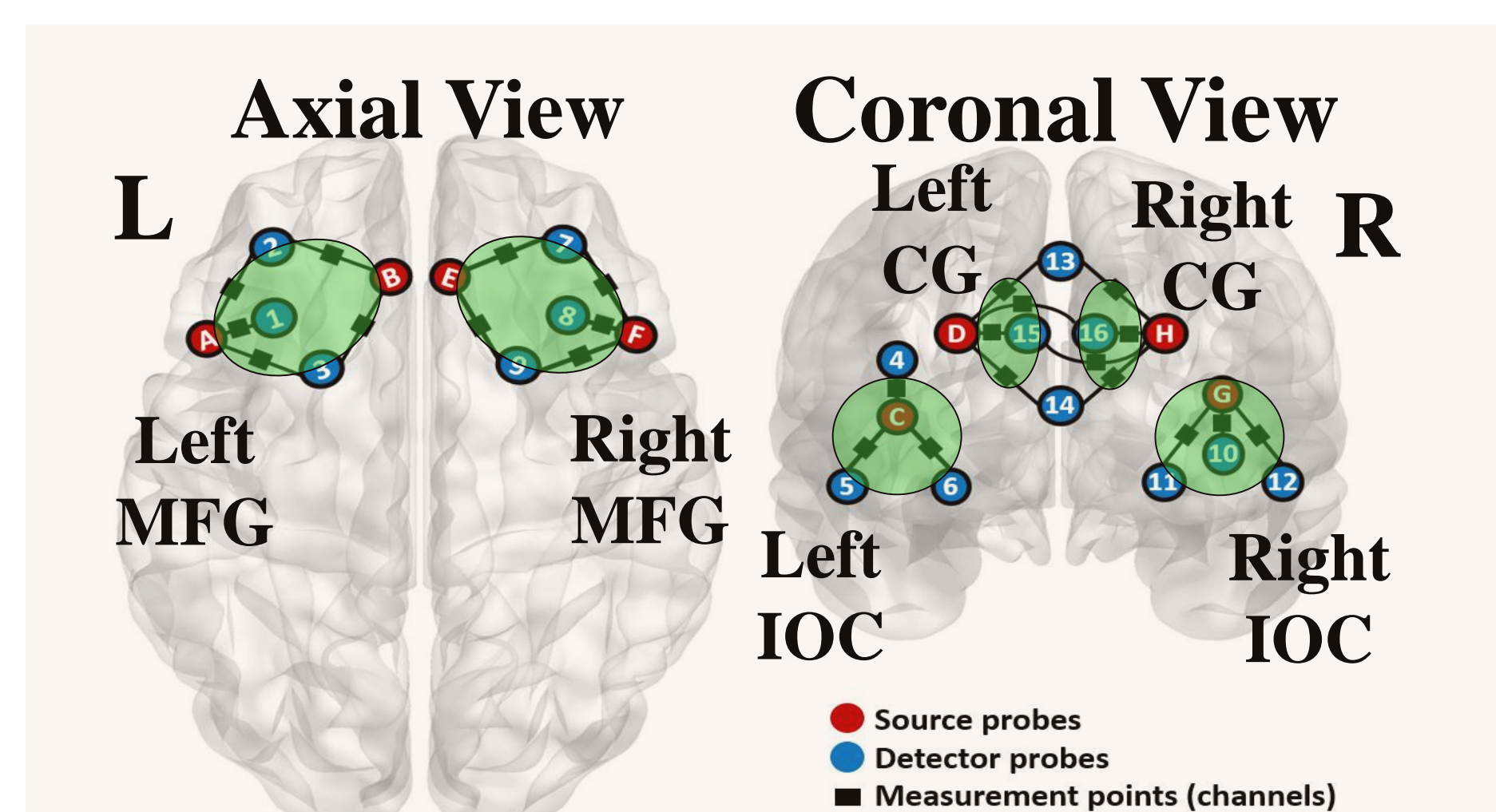


Figure 1. ROIs for visual attention processing.

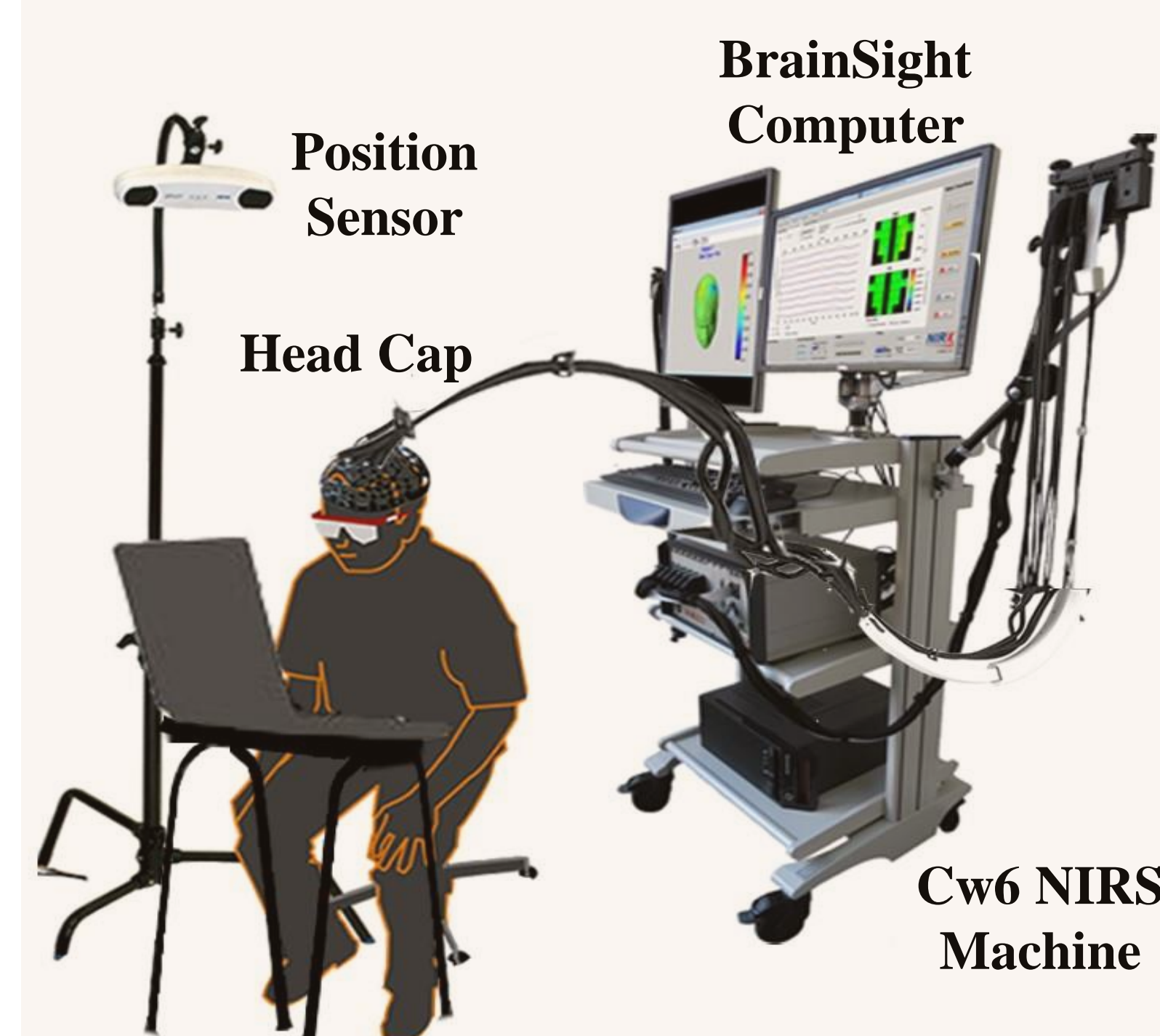


Figure 2. Device Setup.

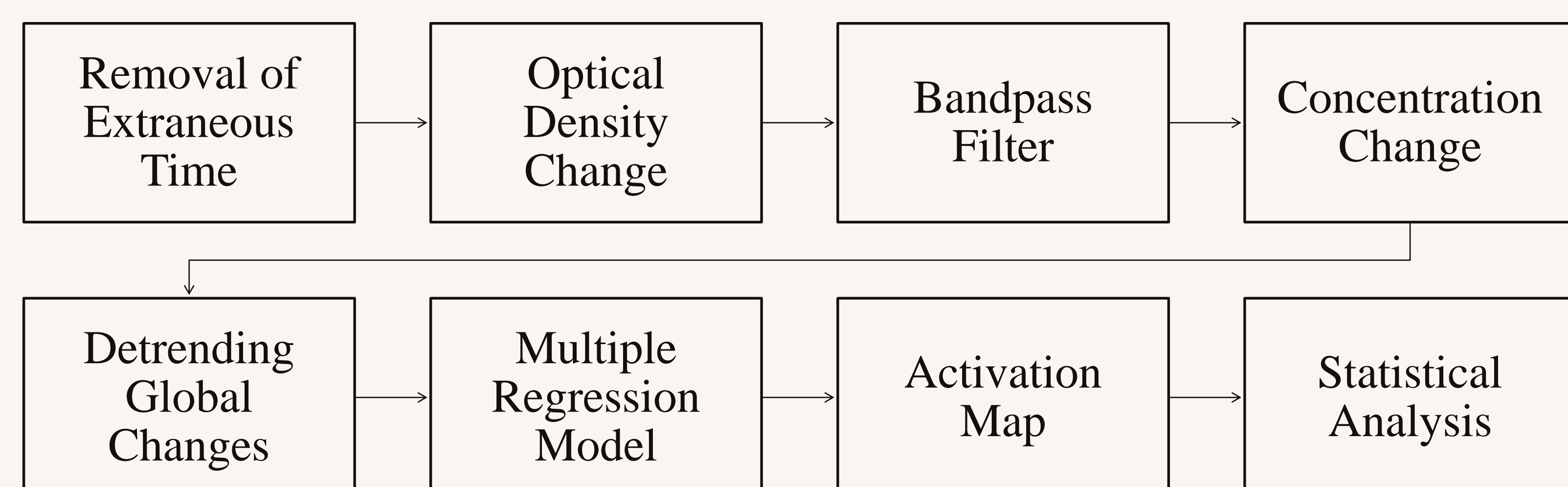


Figure 3. Data Processing Steps.

Results

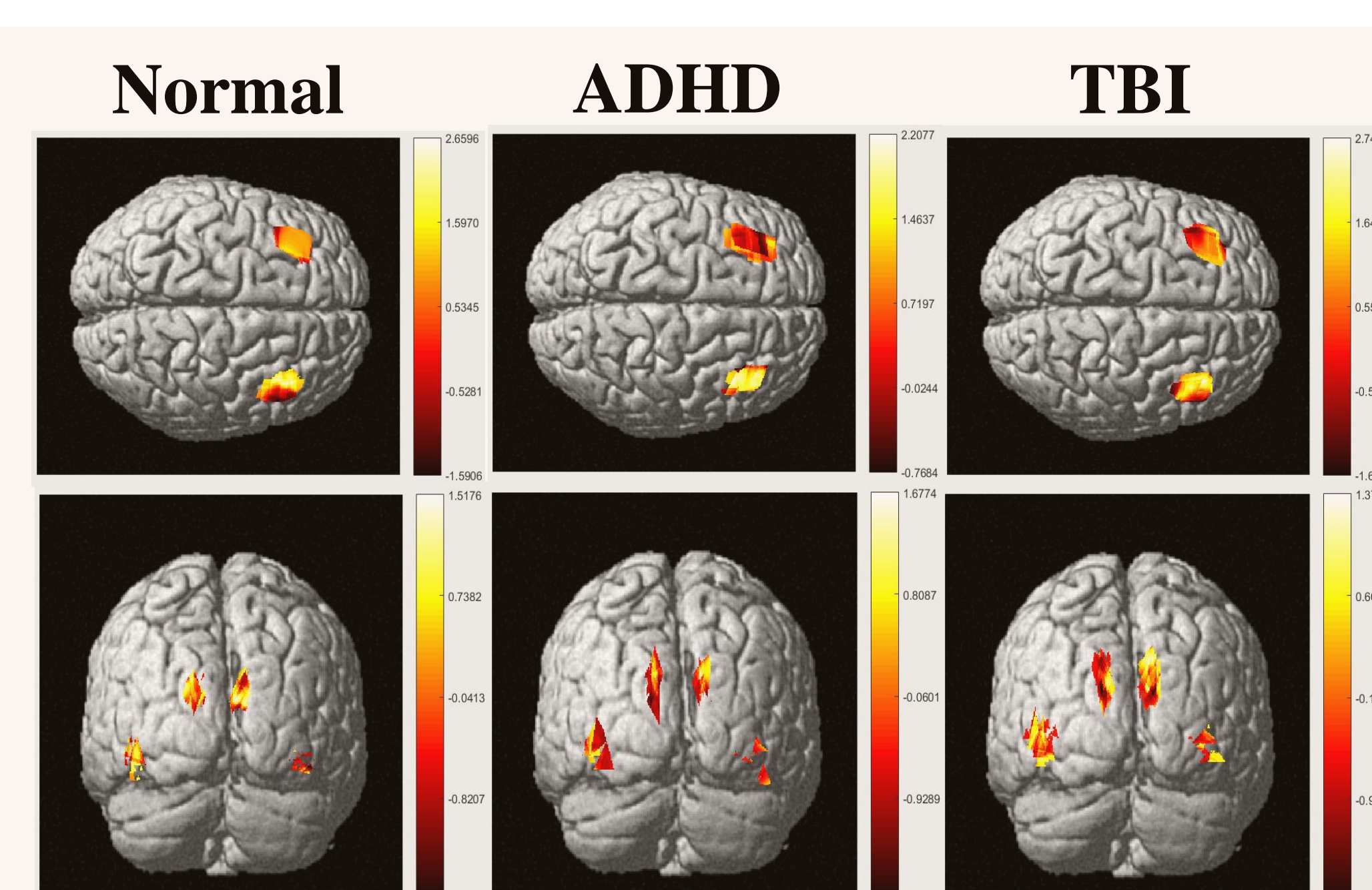


Figure 4. Significant Brain Activation Map of ROIs.

Table 1. Significant Between-Groups Brain Activations.

	ROIs	Sig. p-Value	Post Hoc ^{T-HSD}	
			Groups	p-Value
One-Way ANOVA	Right CG	0.028	TBI > NC	0.027
One-Way ANCOVA	Right CG	0.052	TBI > NC	0.021

Abbreviations: Sig., significance value; T-HSD, Tukey Honestly Significant Difference Post Hoc Test

Table 2. One-way ANCOVA Analysis.

	F	Sig.
Age	1.180	0.282
Gender	0.276	0.602
Group	3.128	0.052

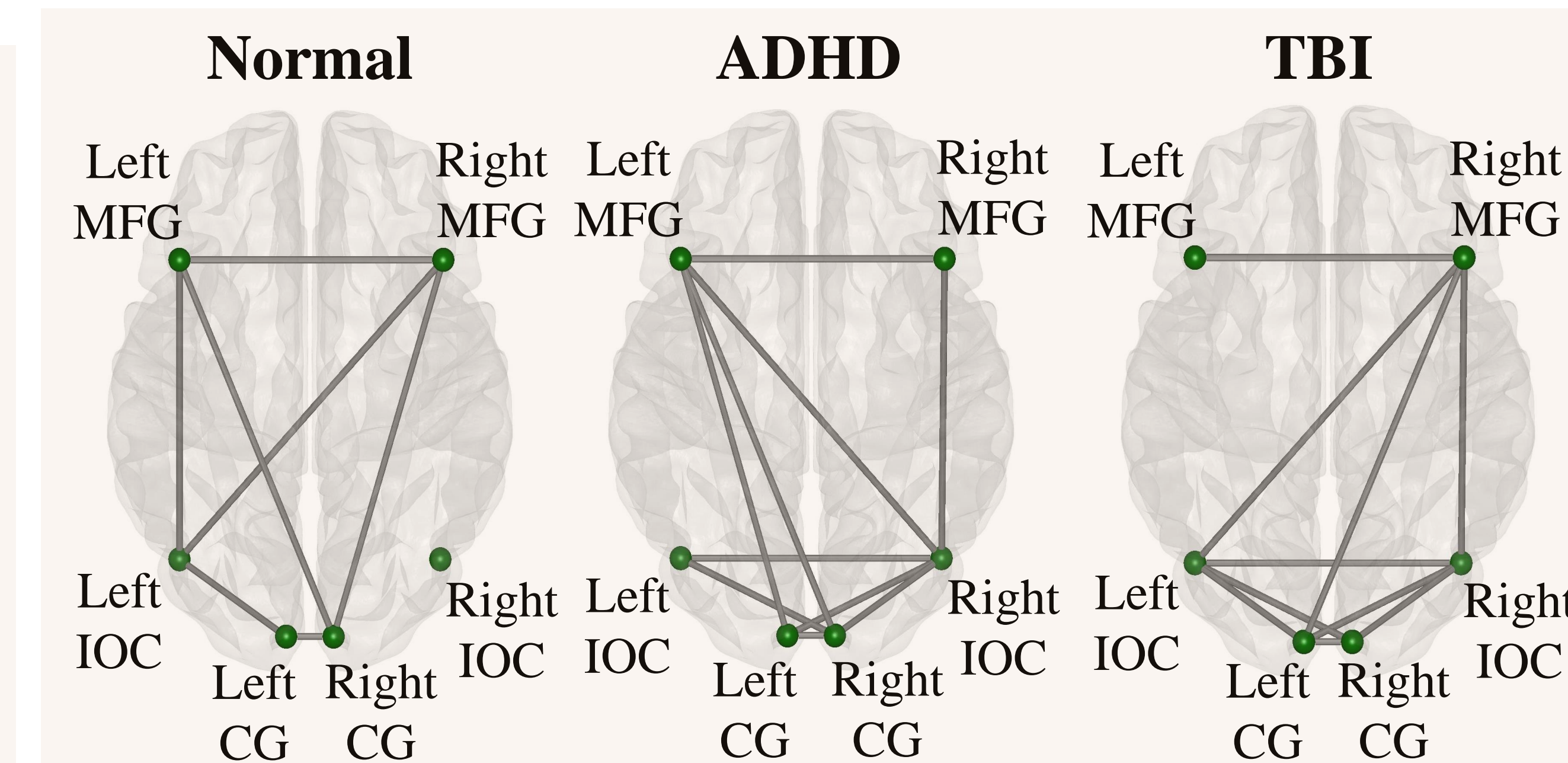


Figure 5. Significant Within Group Brain Connectivity Map.

Table 3. Significantly Activated Between-ROI Brain

	Between-ROI Connectivities	Sig. p-Value	Post Hoc ^{T-HSD}	
			Groups	p-Value
One-Way ANOVA	Left MFG Right CG	0.021	NC > TBI	0.027
	Left CG Right IOC	0.023	ADHD > NC	0.022
	Right CG Right IOC	0.019	TBI > NC	0.014
One-Way ANCOVA	Left MFG Right CG	0.037	ADHD > TBI NC > TBI	0.037 0.018
	Left CG Right IOC	0.027	ADHD > NC	0.009
	Right CG Right IOC	0.021	TBI > NC	0.006

Conclusion

The current data suggests that there are abnormal brain activation in right CG and significantly increased connectivities between left MFG and right CG, left CG and right IOC, and left IOC and right IOC that may play an important role in inattention for young adults with primary ADHD and young adults with TBI.

Age and/or gender did not have a significant effect on the ROI activations and between-ROI connectivities in this study. It did have an effect on the connectivity between left MFG and right CG, albeit insignificant.

Future Work

Future work includes: recruiting more subjects into groups to increase statistical power and using functional magnetic resonance imaging (fMRI) imaging technique in conjunction with fNIRS imaging technique

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References

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- Wu, Z., Luo, Y., Baskar, A., & Li, X. (2017). Testing cortical activation responding to visual attention in young adults with traumatic brain injury – a functional near-infrared spectroscopy pilot study.