Baylor College of Medicine

The Relation of Regional DTI with Incentivized Event-Based Prospective Memory in Children following TBI

Cognitive Neuroscience Laboratory

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Limited data currently exist regarding brain-behavior relations of event-based prospective memory (EB-PM) in children with traumatic brain injury (TBI). Previous studies by our group have reported significant increases in EB-PM performance using monetary incentives.

Objective

The objective of this study was to demonstrate the relation between incentive-based EB-PM performance and alterations in regional diffusion tensor imaging (DTI) indices in children with TBI.

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Participants

Participants were children (range 7-17 years, mean = 11.9) with moderate-to-severe TBI (n=39) or controls with orthopedic injuries (OI; n=40) prospectively recruited into a longitudinal study of outcome following TBI and evaluated at approximately 3 months (mean=123.0 ± 28.1 days) postinjury. Participants were administered an incentive-based EB-PM task and underwent neuroimaging. DTI was registered to an anatomical MRI, and white matter (WM) parcellation was performed automatically through the FreeSurfer software suite (#3). Average fractional anisotropy (FA) was derived for each WM parcellation region. Regions shown to be involved in fMRI studies of EB-PM in healthy adults were analyzed.

Prospective Memory Task

High Motivation Condition

Children were instructed "We will be doing several different types of tests this morning. I want you to listen carefully and every time I say 'Let's try something different,' I would like you to say '*Please give me 3 points.*' At the end of testing today, you'll be able to trade those points in for dollar bills. The more points you get, the more dollar bills you'll get."

Low Motivation Condition Children were given same instructions as above, but were incentivized with pennies instead of dollars.

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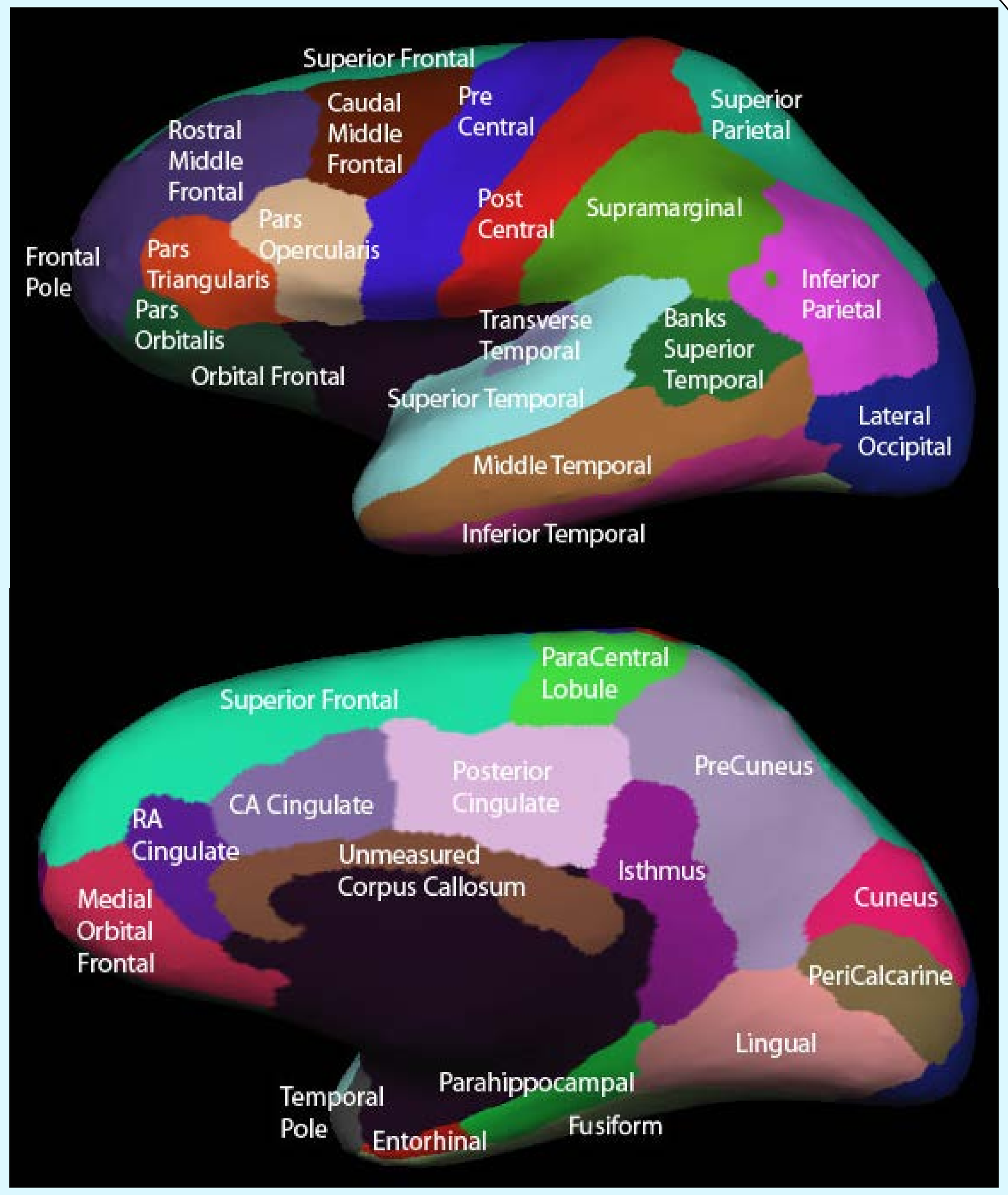

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ROI	*OI*	*TBI*	*Statistics*	*FDR-Dep**
L Lateral Orbitofrontal	.330 (.025)	.296 (.045)	F(1,76)=14.40, p < .0001	p < .0001
L Medial Orbitofrontal	.308 (.033)	.272 (.039)	F(1,76)=14.40, p < .0003	p < .003
R Medial Orbitofrontal	.327 (.037)	.283 (.053)	F(1,76)=13.26, p < .0005	p < .003
L Anterior Cingulate	.498 (.049)	.438 (.076)	F(1,76)=15.60, p < .0002	p < .003
R Lateral Orbitofrontal	.327 (.028)	.287 (.034)	F(1,76)=14.61, p < .0003	p < .003
L Fusiform Gyrus	.316 (.018)	.292 (.035)	F(1,76)=18.30, p < .0004	p < .005
L Isthmus Cingulate	.509 (.034)	.463 (.071)	F(1,76)=14.66, p < .0003	p < .008
R Isthmus Cingulate	.478 (.039)	.433 (.074)	F(1,76)=11.24, p < .001	p < .03
R Rostral Middle Frontal	.290 (.022)	.274 (.023)	F(1,76)=9.86, p < .002	p < .03
R Pars Opercularis	.314 (.021)	.292 (.037)	F(1,76)=10.14, p < .002	p < .03
R Superior Frontal	.323 (.023)	.304 (.032)	F(1,76)=9.76, p < .003	p < .05
L Parahippocampal	.285 (.031)	.263 (.037)	F(1,76)=7.75, p < .007	p < .05

** Benjamini, Y. and Yekateuli, D. (2001). The control of the false discovery rate in multiple testing under dependency. Annals of Statistics, 29, 1165–1188.*

Procedures

1. Regions of interest (ROIs) were identified from existing fMRI studies of PM in healthy controls.
2. ROIs demonstrating significant DTI group differences after adjusting for False Discovery Rate for Dependencies (#4) were retained for further analyses.
3. No ROIs correlated with EB-PM performance in the OI group under any condition (all $p > .10$).
4. Significant correlations were found between ROIs and High Motivation performance in the TBI group. (#5) and shown in FreeSurfer rendering (#6).

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ROI	*EB-PM Condition, TBI Group Only*	
	High Motivation	*Low Motivation*
L Lateral Orbitofrontal	r = .44, p = .005	r = .12, p = .47
L Medial Orbitofrontal	r = .41, p = .009	r = .08, p = .64
R Medial Orbitofrontal	r = .28, p = .08	r = .20, p = .21
L Anterior Cingulate	r = .41, p = .009	r = .36, p = .02
R Lateral Orbitofrontal	r = .44, p = .005	r = .12, p = .47
L Fusiform Gyrus	r = .45, p = .004	r = .08, p = .64
L Isthmus Cingulate	r = .41, p = .009	r = .27, p = .10
R Isthmus Cingulate	r = .47, p < .003	r = .27, p = .10
R Rostral Middle Frontal	r = .48, p < .002	r = .19, p = .26
R Pars Opercularis	r = .29, p = .07	r = .28, p = .08
R Superior Frontal	r = .23, p = .16	r = .05, p = .77
L Parahippocampal	r = .22, p = .19	r = .16, p = .32

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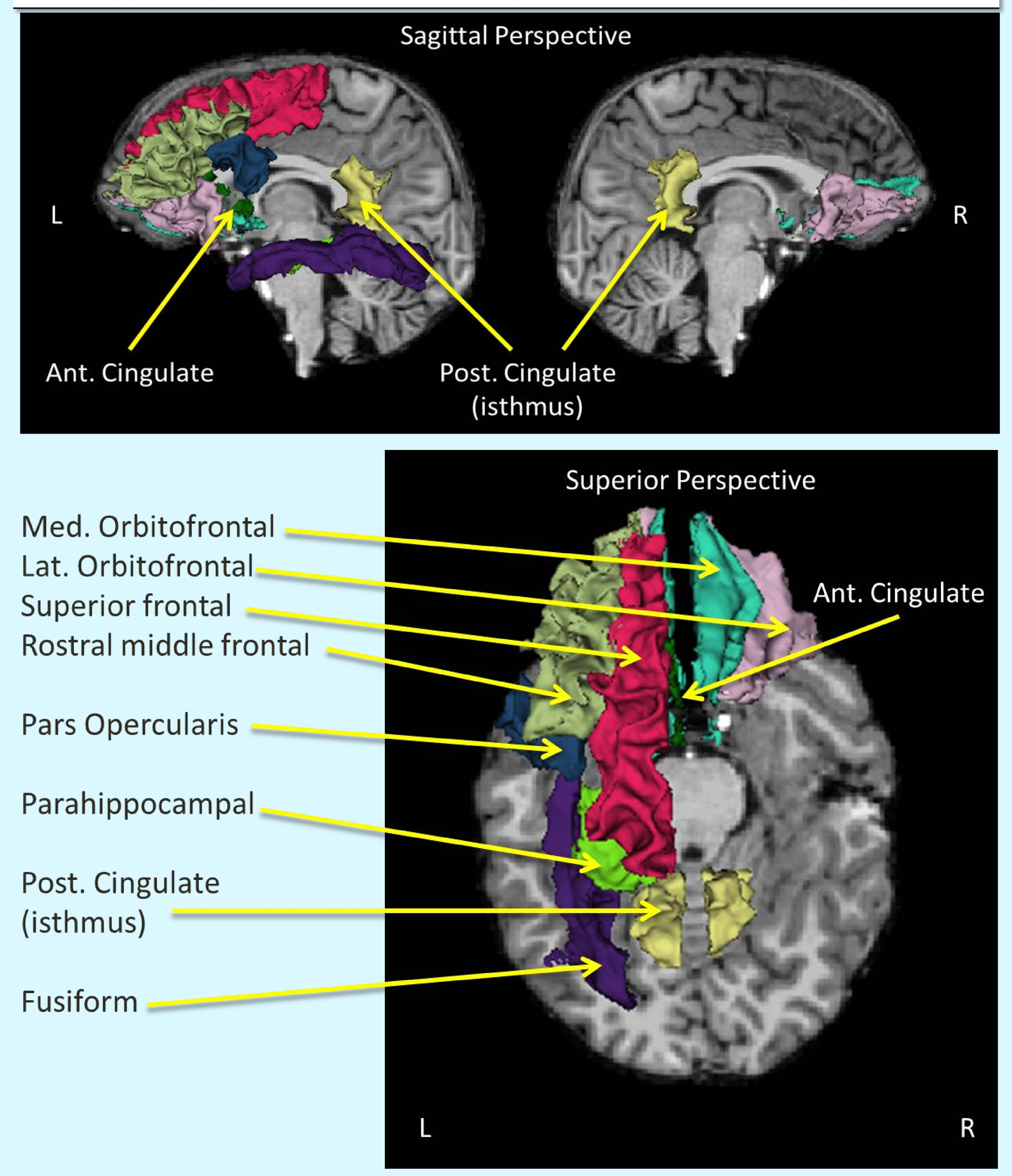

Conclusions

1. Regions important in EB-PM performance are vulnerable to moderate/severe TBI in children.
2. WM integrity of these areas is significantly related to EB-PM performance, almost exclusively under the high motivation condition

These results are consistent with previous studies in healthy adults and extend previous findings of our group by demonstrating structures related to incentive-based EB-PM performance.

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