

An Exploratory Analysis of Youth with Concussion using the Persistent Concussion, Anxiety, Neuropsychology and Neuroimaging (PeCANN) Pilot Project

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Background

- Following **concussion**, as many as 30% of youth will have a complex and prolonged recovery of > 4 weeks
- These **persistent post concussion symptoms (PPCS)** are often accompanied by significant **mental health challenges**
- This creates a significant burden for children and their families

In order to improve the experiences of youth with PPCS and their families, we need to explore measures that assess the broad scope of their challenges.

Objectives

1. **Group comparisons:** how do youth with PPCS differ from same-aged youth on neuropsychological and mental health measures?
2. **Brain-behavior relationships:** how does brain connectivity impact performance on neuropsychological and mental health measures?

Methods

- 16 youth (mean age = 15.625) with PPCS completed:
 - Neuropsychological testing
 - Mental health self- and parent- report measures
 - fMRI scan of brain connectivity

Domain	Measure
Attention	Conners Continuous Performance Test 3 rd ed. (CPT-3)
Memory	Rey Auditory Verbal Learning Test (RAVLT)
Executive Functioning	Delis-Kaplan Executive Function System (D-KEFS) Colour-Word Interference
Working Memory	Weschler Digit Span
Anxiety	Multidimensional Anxiety Scale for Children (MASC)
Internalizing and Externalizing Problems	Child Behavior Checklist-Parent (CBCL); ASEBA Youth Self Report (YSR)
Perfectionism	Child-Adolescent Perfectionism Scale (CAPS)

Brain Connections of Interest:

1. Frontoparietal Network-Amygdala Connectivity Correlations (**FPN-A**)
2. Global Frontoparietal Network Connectivity (**FPN-Global**)

Analyses

- Tests and self-report measures: mean group differences via t-test
- Relationship between brain connectivity, neuropsychological and mental health measures: multiple linear regression

Youth with persistent post-concussion symptoms also have high symptomology on measures of mental health.

Future research should focus on the full scope of challenges after concussion, including cognitive, psychological, and brain network outcomes.



Results

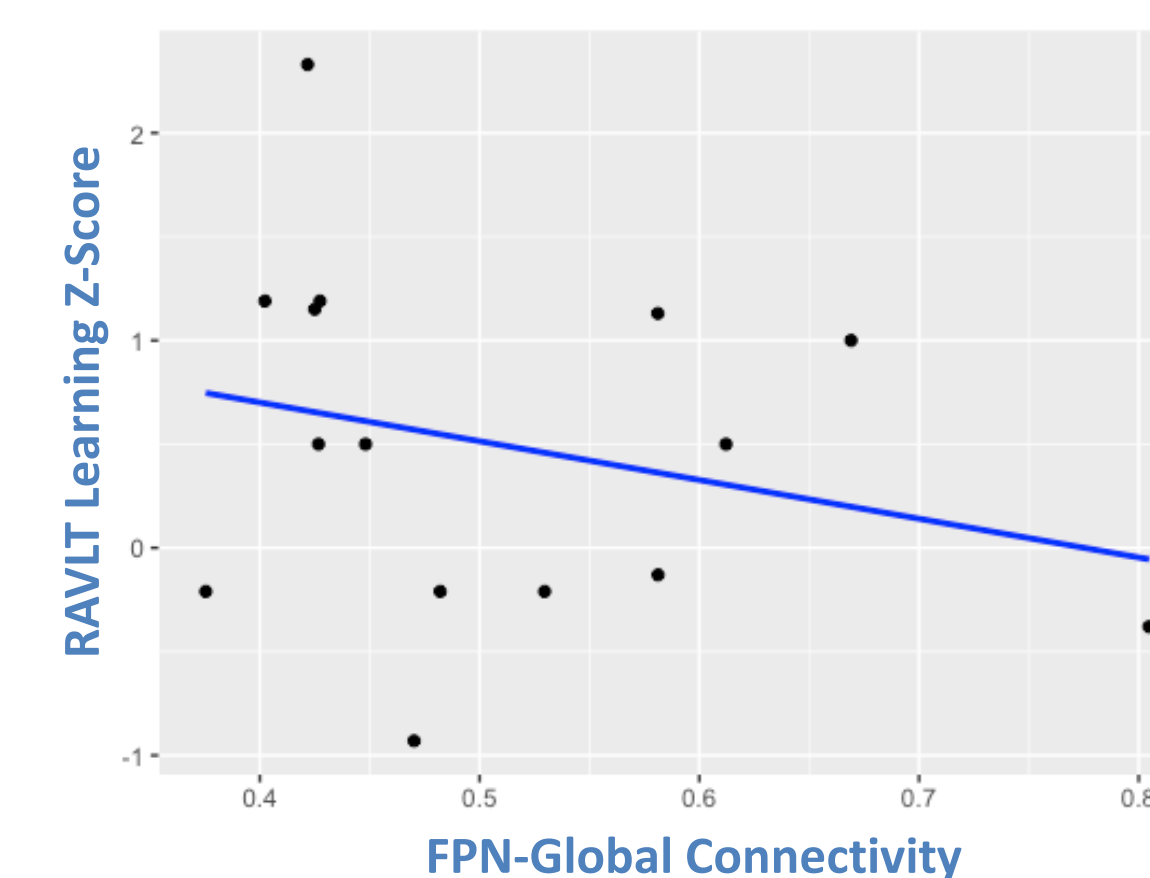
Group Comparisons

Significant group differences were found on the following measures:

Psychological Outcome	PPCS Mean	Normative Mean	p-value
RAVLT Learning (A5)	0.495	0	<0.05
YSR Internalizing Symptoms	62.31	50	<0.001
CBCL Internalizing Symptoms*	64.31	50	<0.000
MASC Generalized Anxiety Symptoms	62.29	50	<0.01
MASC Physical Symptoms	65.00	50	<0.0001
CAPS Self-Prescribed Perfectionism	1.20	1	<0.01

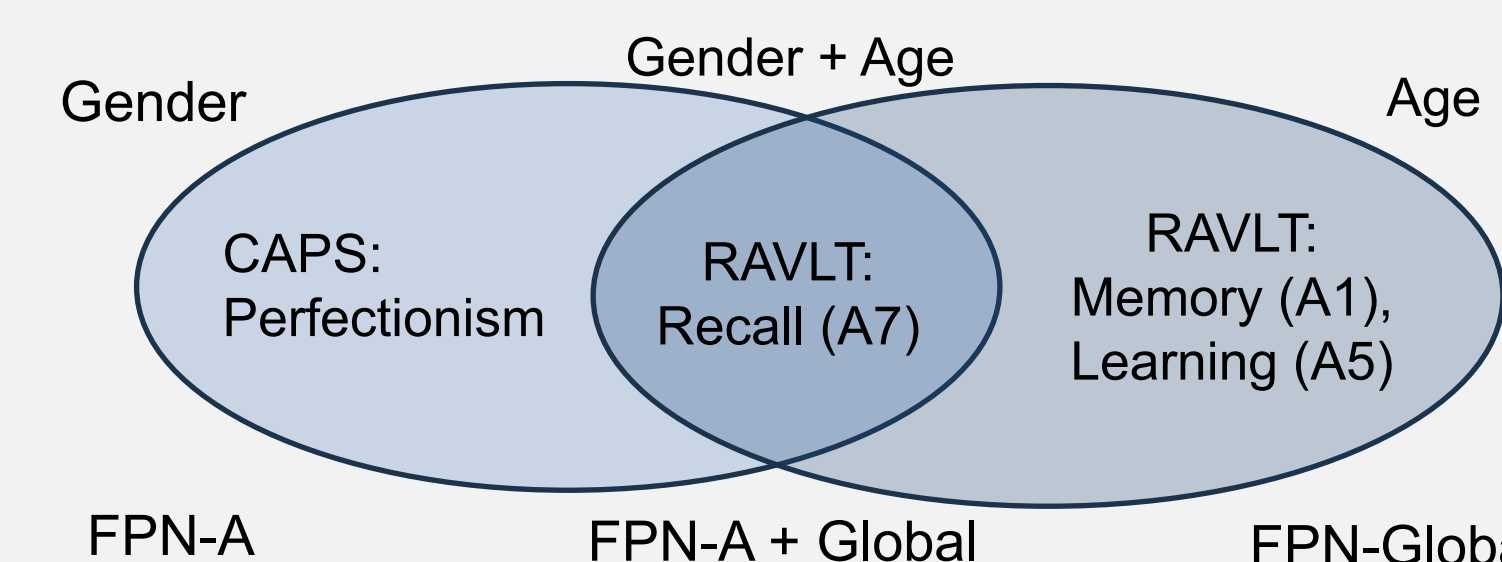
*parent report

Brain-Behavior Relationships



Significant relationship between FPN-Global connectivity and RAVLT learning.
 $\beta = -3.7043, p < 0.05$

Significant Covariates



Next Steps

- Additional investigations into brain-behavior relationships and network correlates for youth with PPCS
- Investigations into how youth with PPCS are similar to and different from other groups with mental health symptomology (e.g., anxiety)

Relevance

- Functional neuroimaging and network and/or regional connectivity as a potential objective biomarker of concussion
- Enhancing clinical decision-making in order to provide optimal care for youth and their families

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