Dynamic functional network connectivity estimated from resting-state fMRI predicts symptom severity in PTSD

Mohammad SE. Sendi1, Sanne van Rooij2, Nathaniel G. Harnett1, Lauren A. M. Lebois1, Vishnu P. Murty3, Tanja Jovanovic4, Stacey House6, Negar Fani2, Zening Fu6, Victor Vergara6, Vince D. Calhoun6, Diego A. Pizzagalli1, Samuel A. McLean7, Kerry J. Ressler1, Jennifer Stevens2, Nikolaos P. Daskalakis1

Introduction

Finding neuroimaging biomarkers for PTSD is important for improving therapy.
Previous studies have focused on static FNC and ignored its dynamics.
The assumption that brain functional network connectivity is static may be incorrect.
The study aims to identify dynamic FNC features associated with PTSD symptom severity.

Clinical and demographic measures

<table>
<thead>
<tr>
<th>Measure</th>
<th>PRE</th>
<th>WK2</th>
<th>WK8</th>
<th>M3</th>
<th>M6</th>
<th>M12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yr) mean</td>
<td>35.07±12.83</td>
<td>35.08±12.34</td>
<td>35.08±12.30</td>
<td>35.08±12.30</td>
<td>35.08±12.30</td>
<td>35.08±12.30</td>
</tr>
<tr>
<td>Sex (M/F)</td>
<td>108/66</td>
<td>106/68</td>
<td>104/68</td>
<td>101/67</td>
<td>103/65</td>
<td>102/65</td>
</tr>
<tr>
<td>Education (yr) mean</td>
<td>14.75±2.43</td>
<td>14.65±2.43</td>
<td>14.65±2.43</td>
<td>14.65±2.43</td>
<td>14.65±2.43</td>
<td>14.65±2.43</td>
</tr>
<tr>
<td>BMI at ED (mean)</td>
<td>29.95±7.81</td>
<td>28.95±7.81</td>
<td>28.95±7.81</td>
<td>28.95±7.81</td>
<td>28.95±7.81</td>
<td>28.95±7.81</td>
</tr>
</tbody>
</table>

PGLS (mean) | 30.57±15.76 | 30.73±15.89 | 30.73±15.89 | 30.73±15.89 | 30.73±15.89 | 30.73±15.89 |

PCLS correlation with age | 0.0395 | 0.0395 | 0.0395 | 0.0395 | 0.0395 | 0.0395 |

PCLS correlation with education | -0.0474 | -0.0474 | -0.0474 | -0.0474 | -0.0474 | -0.0474 |

PCLS correlation with BMI | 0.65±12 | 0.65±12 | 0.65±12 | 0.65±12 | 0.65±12 | 0.65±12 |

PCLS correlation with age | 0.3906 | 0.3906 | 0.3906 | 0.3906 | 0.3906 | 0.3906 |

PCLS correlation with education | -0.0474 | -0.0474 | -0.0474 | -0.0474 | -0.0474 | -0.0474 |

PCLS correlation with BMI | 0.3906 | 0.3906 | 0.3906 | 0.3906 | 0.3906 | 0.3906 |

Sex-related PCLS difference (state 1 vs state 3) | 0.43±12 | 0.43±12 | 0.43±12 | 0.43±12 | 0.43±12 | 0.43±12 |

Three dFNC states are identified

Using k-mean clustering, we identified three distinct states.

State 1 exhibited higher connectivity within the cognitive control network (CCN) and among sensory networks.

State 2 demonstrated the lowest connectivity when compared to State 1 and State 3.

Methods

Participants were enrolled within 72 hours of trauma exposure from AURORA (Freeze 4.0) study.
AURORA is a multisite longitudinal study that investigates recovery after trauma.
Trauma incidents included car accidents, falls >10 feet, physical assault, sexual violence, or mass casualty incidents.
PCLS (measure of PTSD) assessed at different time points: pre-trauma (PRE), week 2 (WK2), week 8 (WK8), month 3 (M3), month 6 (M6), and month 12 (M12) after trauma.

ClinicalAssessment

Preprocessing

Step 1: All functional MRI images were segmented into 53 independent components.
Step 2: Group independent component analysis
Step 3: Time course signal regression
Step 4: Connectivity ID

Conclusion and Future work

Our study identified dynamic functional network connectivity features that predict PTSD symptom severity.
Dynamic functional network connectivity can be used to predict PCL-5 scores at different time points.
The visual and sensory motor network connectivity show potential as a biomarker for PTSD.

Future directions

We are currently investigating whether a polygenic risk score for PTSD can be used to predict clinical and neuroimaging phenotypes.
Additionally, we are exploring the interaction between genetics, demographic and environmental factors, and neuroimaging features in predicting the trajectory of PTSD.

Grant Support

T32MH125786 (to W. Carlezon/K. Ressler, MPhs)
NIMH U01MH110925

Results

Correlation coefficient (r)

State 1 OCR had a negative correlation with PCL-5 in WK2 and M3.
State2 OCR had a positive correlation PCL-5 of M3.
Number of transition correlated with PCL-5 of M12.

Preprocessing:

53 independent components were extracted from subcortical network (SCN), auditory network (ADN), sensorimotor network (SMN), visual sensory network (VSN), and default mode network (DMN), by Group-ICA.

For any question contact: msendi@mclean.harvard.edu