

Neuroimaging of Nonconcussive Blast Exposure in OEF/OIF/OND Veterans

Meghan Robinson, PhD

2015 State of the Science Meeting

“Does Repeated Blast-Related Trauma Contribute to the
Development of Chronic Traumatic Encephalopathy (CTE)?”

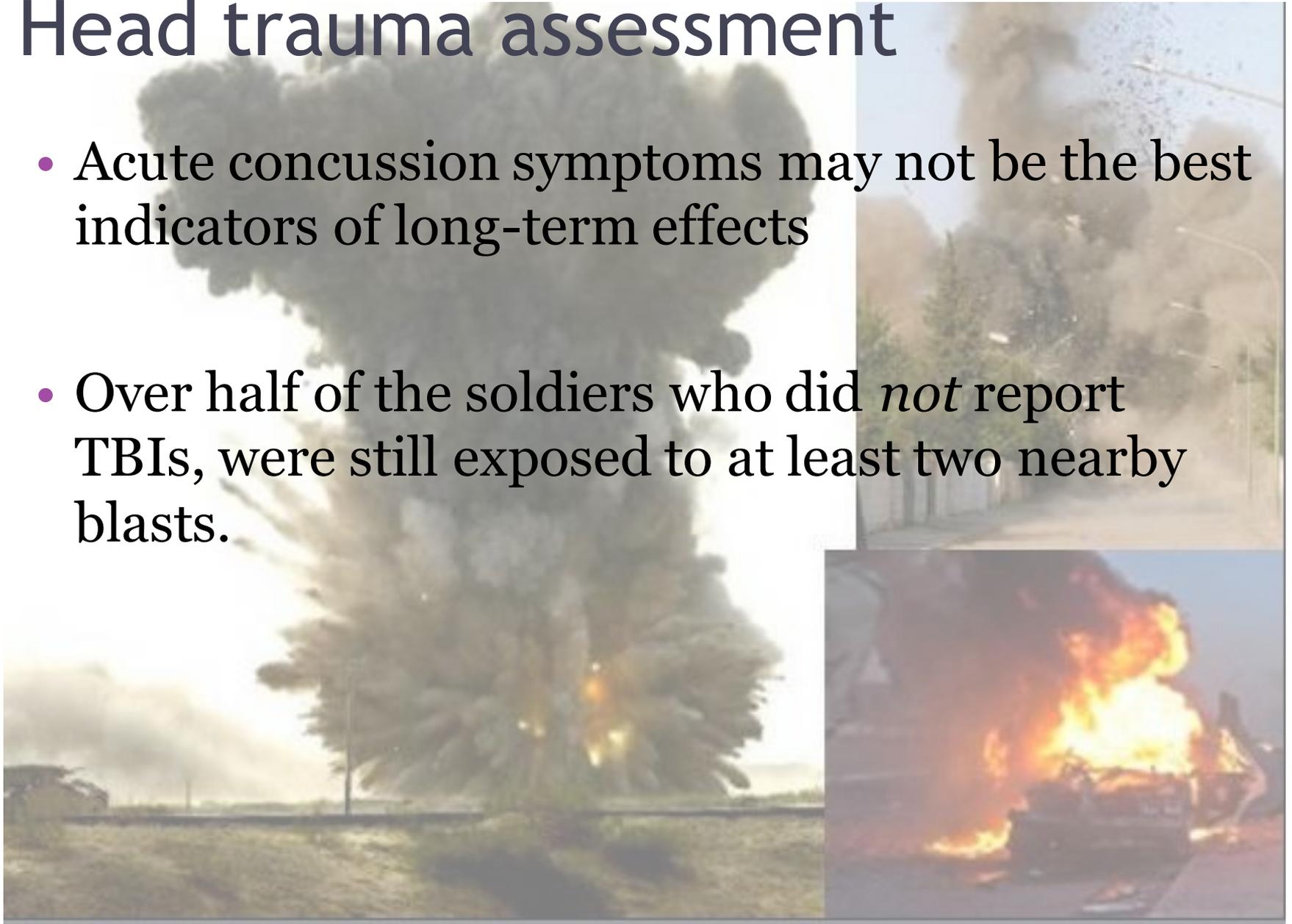
11/4/2015

Today...

- Blasts-- especially those at close-range and even when they do not result in concussive symptoms-- can produce lasting changes to the brain
- Two published studies, and some preliminary data to support this

Head trauma assessment

- Acute concussion symptoms may not be the best indicators of long-term effects
- Over half of the soldiers who did *not* report TBIs, were still exposed to at least two nearby blasts.





BLASTS - *SIMULTANEOUS*
physical and psychological trauma
PTSD, Depression, Pain, Sleep, Substance use

Translational Research Center for TBI and Stress Disorders (TRACTS)

- OEF/OIF/OND Veterans and pre-deployed service members from the Greater Boston area, n=480
- Assessed through:
 - Neuropsychological Testing
 - Clinical Assessment
 - Physical Assessment (Blood, DNA, physical exam)
 - MRI Imaging

Close-Range Blast Exposure is Associated With Altered Functional Connectivity in Veterans Independent of Concussion Symptoms at Time of Exposure

**Meghan E. Robinson,^{1,2*} Emily R. Lindemer,^{1,2}
Jennifer R. Fonda,² William P. Milberg,^{2,3,4}
Regina E. McGlinchey,^{2,3,4} and David H. Salat^{1,2,5}**

¹*Neuroimaging Research for Veterans Center (NeRve), VA Boston Healthcare System, Boston, Massachusetts*

²*Translational Research Center for TBI and Stress Disorders (TRACTS), VA Boston Healthcare System, Boston, Massachusetts*

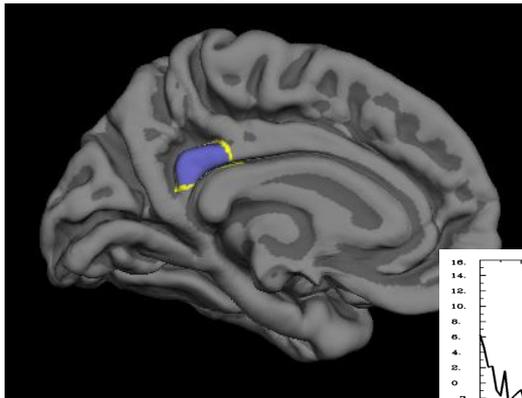
³*Department of Psychiatry, Harvard Medical School, Boston, Massachusetts*

⁴*Geriatric Research, Education, and Clinical Center, (GRECC), VA Boston Healthcare System, Boston, Massachusetts*

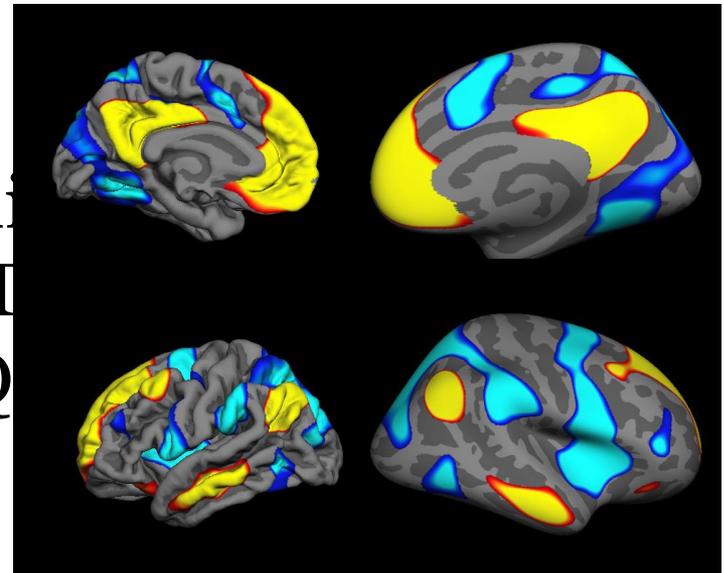
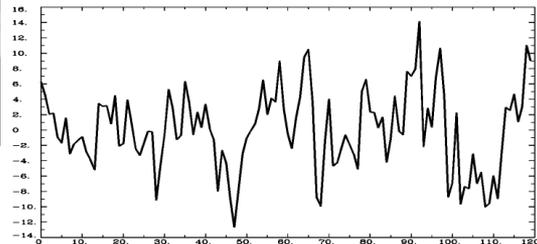
⁵*A. A. Martinos Center for Biomedical Imaging, Charlestown, Massachusetts*

Methods

- First 203 TRACTS participants, 134 records
- Seed-based resting state functional connectivity to a surface-defined seed in the posterior cingulate



s using general l
CAPS score (PT

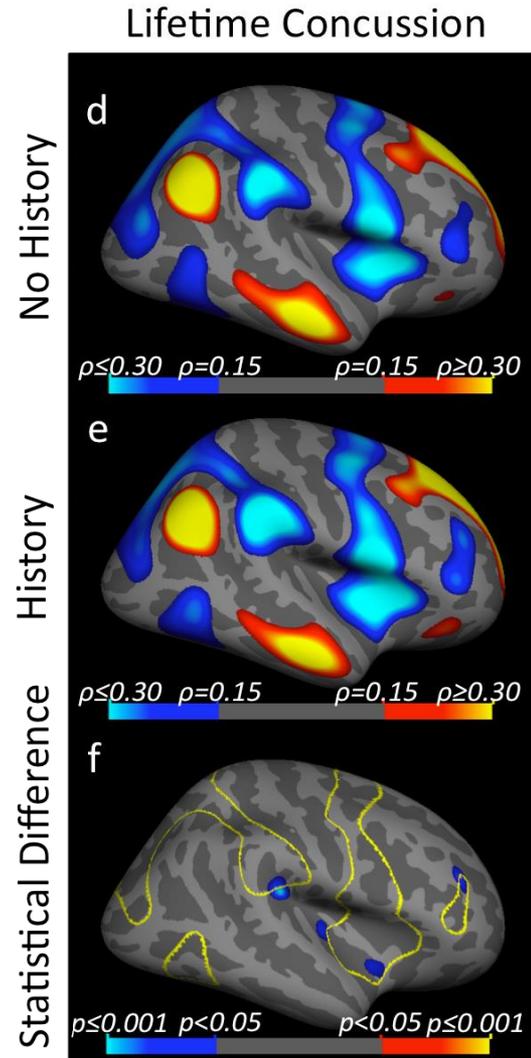


No significant differences
due to concussion

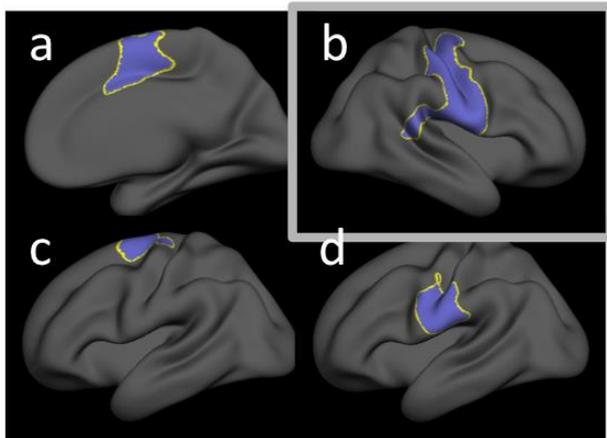
... or 3 or more TBI

... or blast TBI

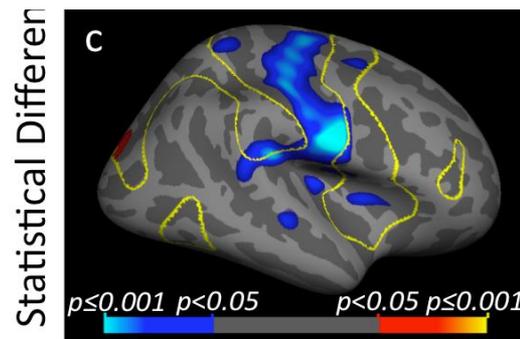
... or, within participants
with PTSD, Military TBI



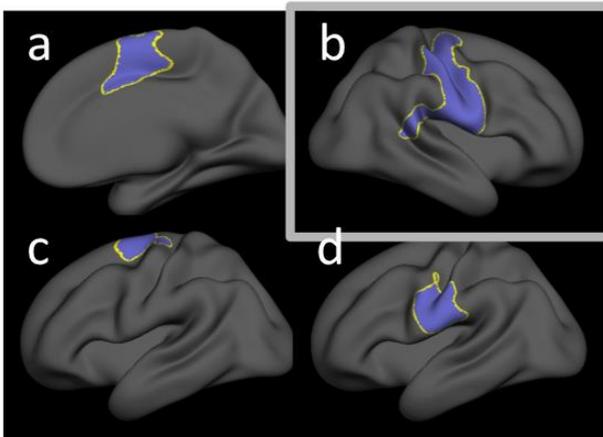
Close-Range Blast is associated with altered fcMRI, while concussion is not



of deployment, Pain,
Sleep, summed time
TBI LOC

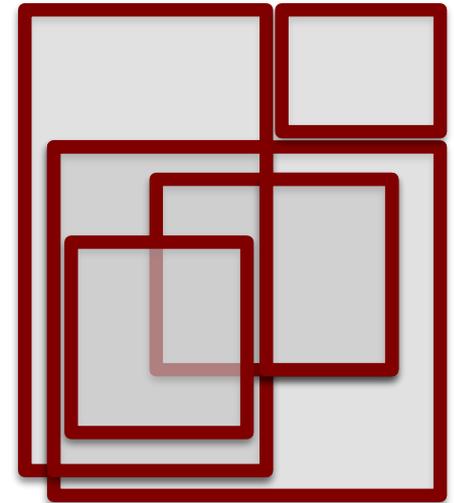
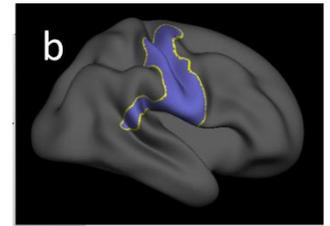


Blast proximity



- No Blunt TBI
- Hx of Blunt TBI
- Blast TBI
- No Blast TBI

Blast and TBI History



Summary

- Close-range blast exposures, even without concussion symptoms, are associated with changes in DMN fcMRI
 - Cannot be attributed to comorbid factors such as PTSD, sleep, or pain
 - Effects are much larger than those of concussion, which could not be detected at all
 - Specific to blasts at close-range
 - Present many months after the encounter

Military blast exposure, ageing and white matter integrity

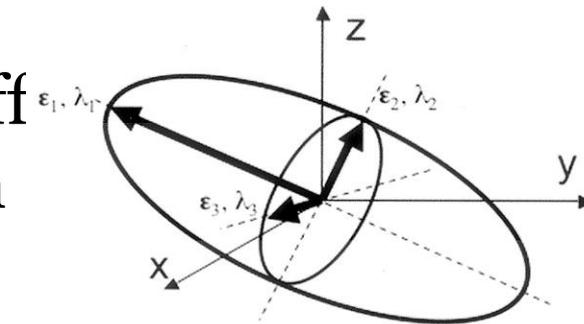
**Benjamin B. Trotter,^{1,2} Meghan E. Robinson,^{1,2} William P. Milberg,^{1,3}
Regina E. McGlinchey^{1,3} and David H. Salat^{1,2,3,4}**

Mild traumatic brain injury, or concussion, is associated with a range of neural changes including altered white matter structure. There is emerging evidence that blast exposure—one of the most pervasive causes of casualties in the recent overseas conflicts in Iraq and Afghanistan—is accompanied by a range of neurobiological events that may result in pathological changes to brain structure and function that occur independently of overt concussion symptoms. The potential effects of brain injury due to blast exposure are of great concern as a history of mild traumatic brain injury has been identified as a risk factor for age-associated neurodegenerative disease. The present study used diffusion tensor imaging to investigate whether military-associated blast exposure influences the association between age and white matter tissue structure integrity in a large sample of veterans of the recent conflicts ($n = 190$ blast-exposed; 59 without exposure) between the ages of 19 and 62 years. Tract-based spatial statistics revealed a

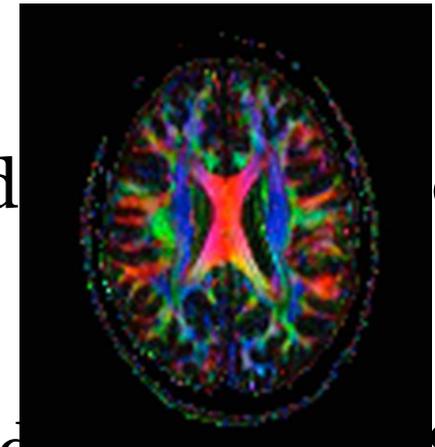
Methods

- First 350 TRACTS participants, 268 records
- 60-direction DTI analyzed with TBSS

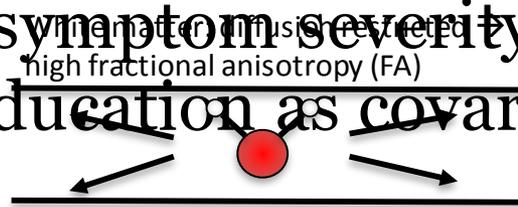
- Examined diffusion matter health



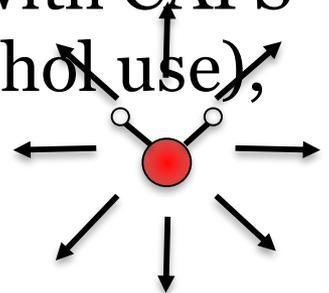
ed d e



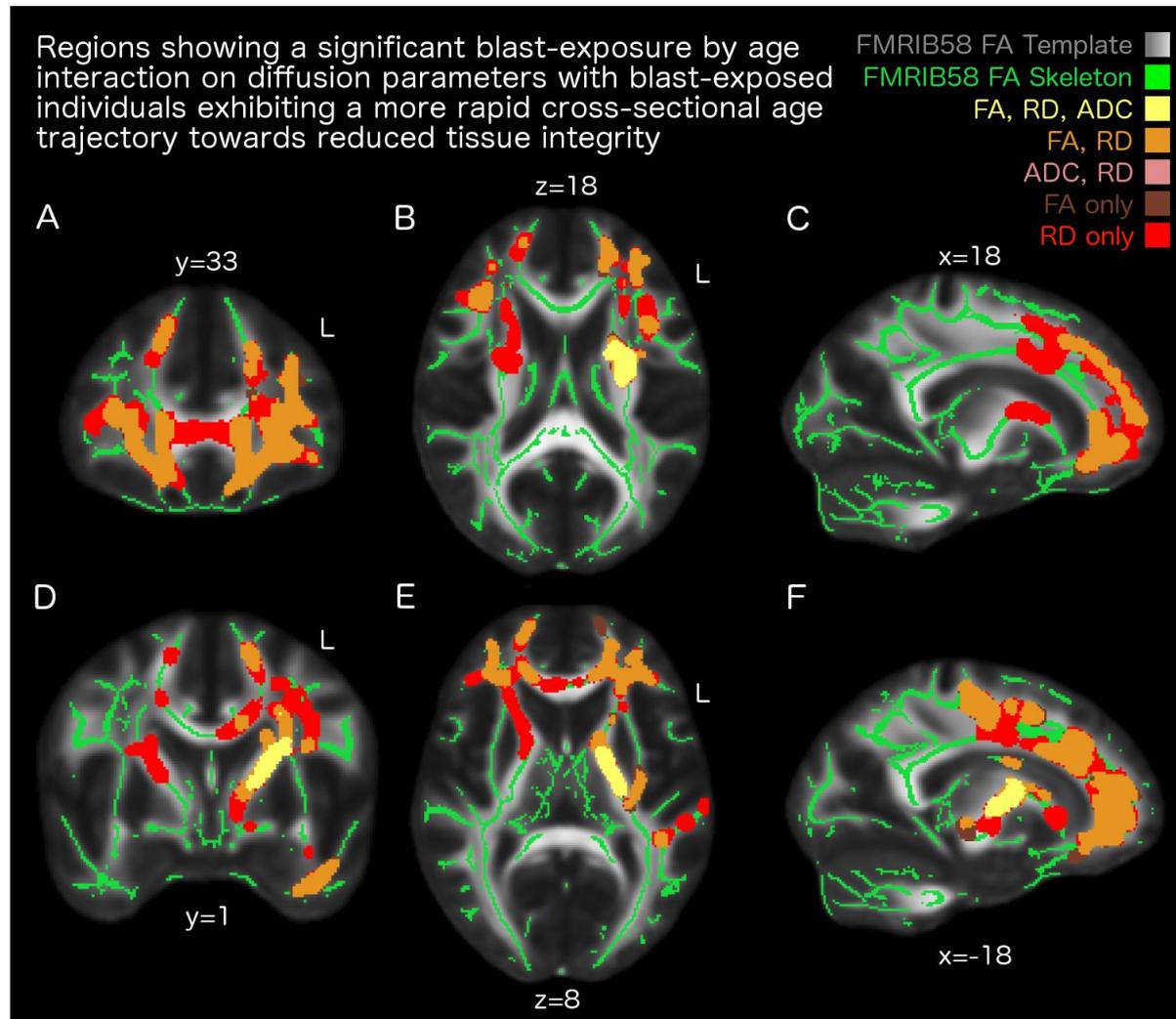
- Comparisons using general linear models with CARS score (PTSD symptom severity), LDH (alcohol use), gender and education as covariates



Brain matter and CSF: diffusion unrestricted → low FA approaching isotropic FA=0

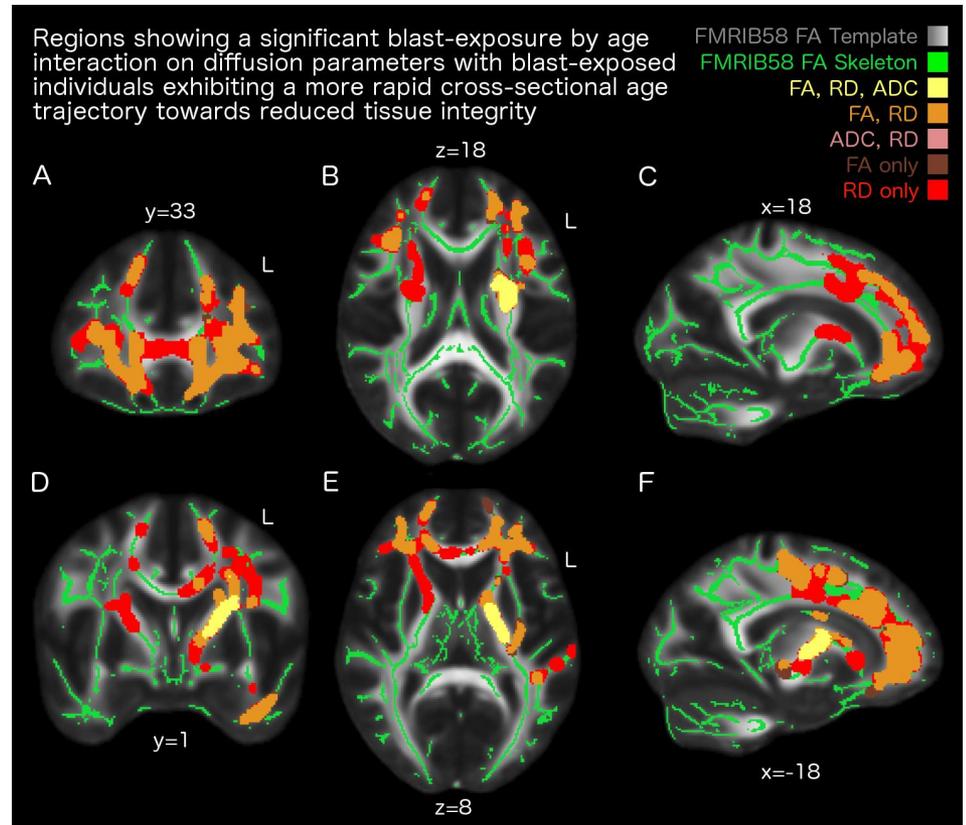


Greater Age Effects in White Matter for Veterans with Blast Exposure



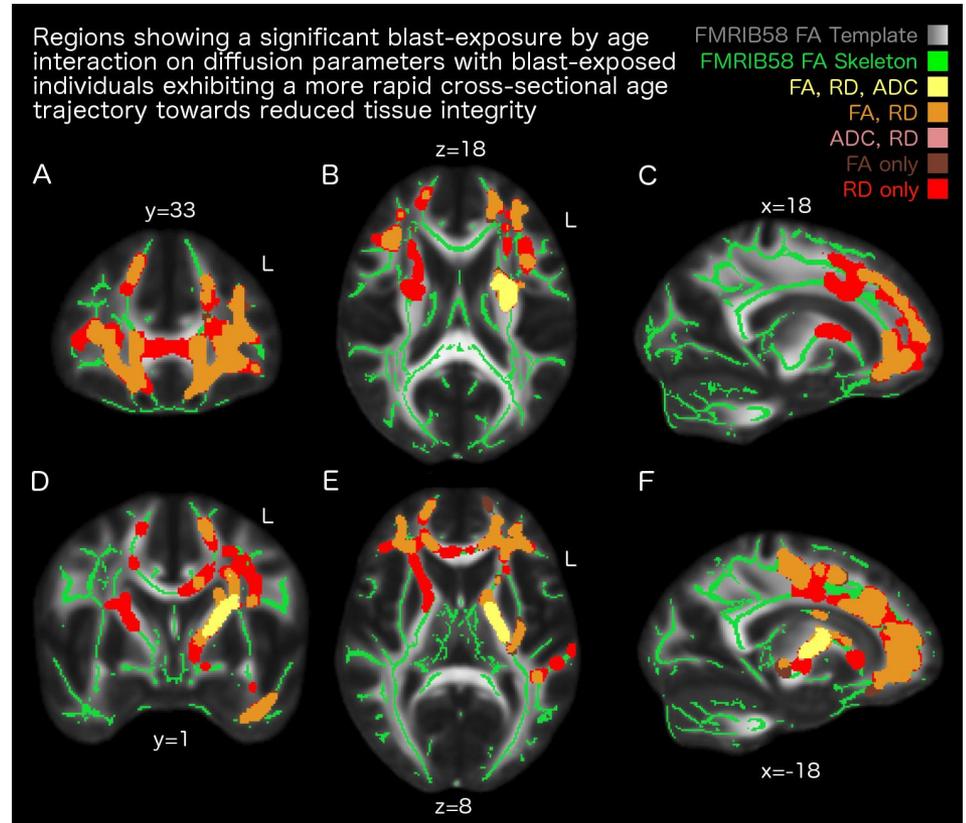
Greater Age Effects in White Matter for Veterans with Blast Exposure

- Once again, these effects were not apparent for history of TBI
 - ... or 2 or more TBI
- And they cannot be attributed to
 - PTSD (CAPS)
 - Alcohol use
 - Sleep impairment
 - Depression (Antidepressants)
 - Anxiety
 - Stress
 - Pain
 - History of TBI
 - Number of TBIs



Greater Age Effects in White Matter for Veterans with Blast Exposure

- Largely fell within areas that demonstrated age effects for the entire cohort
- Weak effects of number of blasts



Summary

- Blast exposure, even without concussive symptoms at the time of exposure, is associated with more rapid cross-sectional age-related changes in white matter
 - Cannot be attributed to comorbid factors such as PTSD, sleep, alcohol, or pain
 - Effects are much larger than those of concussion, which could not be detected at all
 - Suggests an underlying neurodegenerative process

Future Work and Work in Progress

- Cognitive Differences
- Clinical Outcomes
- Other Neuroimaging Studies
 - T807 – Tau PET tracer

Translational Research Center for TBI and Stress
Disorders
VA RR&D TBI Center of Excellence
VA Boston Healthcare System

heartbrain.hms.harvard.edu



The “*TRACTS* Team”