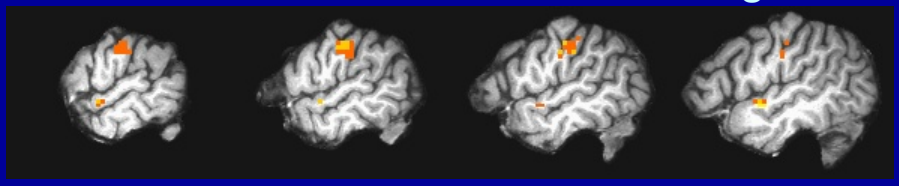
Quantitative Sensory Testing (QST) fMRI of GW Veterans

- Pain, tingling and numbness are very widespread symptoms of ill Gulf War veterans (Haley and Kurt, JAMA, 1997)
  - Also report multiple chemical sensitivities
- Quantitative Sensory Testing of Gulf War veterans
  - Increased cooling and warming detection thresholds observed (Jamal et al., 1996; Haley et al. unpub)
- Performed fMRI of QST on Groups A and B
  - Hot pain on right inner forearm
  - Warm sensation
  - No significant group difference found in hot pain and warm sensation thresholds tested outside the scanner

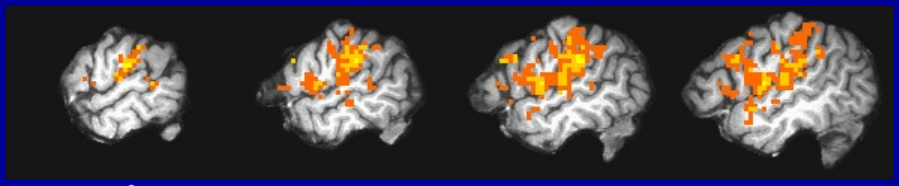
Pain Activation: Left Lateral Sagittal



$p < 1 \times 10^{-6}$

Group B

t_{10}= 10+ t_{10}= -10

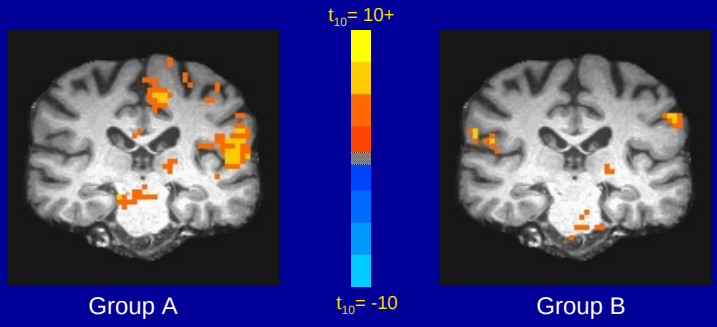


$p < 1 \times 10^{-6}$

Group A

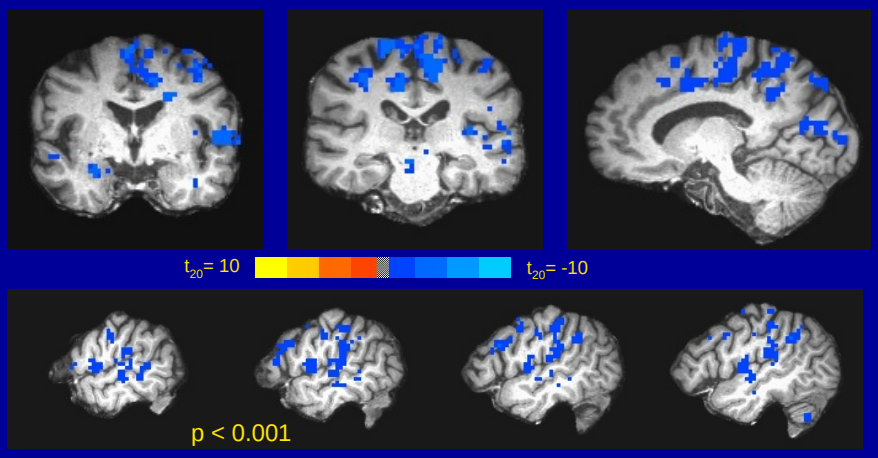
Pain Activation

$p < 1 \times 10^{-6}$



Group A - higher activation in cingulate, left insular cortex and brain stem
Group B - higher activation in right superior temporal gyrus

Pain: Group B – Group A



Group A: significantly higher activation in left insular cortex, S1, S2, superior temporal gyrus and posterior parietal cortex, and in
Bilateral cingulate gyrus, SMA, medial frontal cortex and right amygdala

Pain Activation Summary

- Group B ($p < 0.000001$)
- left ~ right & focused: primary and secondary somatosensory cortices, posterior parietal cortex, insular cortex, pre-motor cortex, cerebellum, thalamus and basal ganglia

- Group A ($p < 0.000001$)
- left >> right & widespread: primary and secondary somatosensory cortices, posterior parietal cortex, insular cortex, supplementary motor area, amygdala, anterior cingulate, cingulate, primary motor cortex, pre-motor cortex, cerebellum; bilateral thalamus and basal ganglia.

A > B ($p < 0.001$):
left: primary & secondary somatosensory cortices, posterior parietal cortices, insula, posterior cingulate, cerebellum
bilateral: cingulate gyrus, supplementary motor area, medial frontal cortex, brainstem

Implications

- Although thresholds for detecting heat pain were similar in Groups A & B, Group A showed higher brain activation than Group B from the same pain stimuli.
- If Group A is the ill group, this excessive reaction of the brain to pain indicates an abnormality of pain processing in the brains of ill GW veterans.
- This brain hyper-reactivity to sensory stimuli might help explain the pain, tingling and numbness reported by many ill GW veterans[1]
- Brain hyper-reactivity to sensory stimuli might also explain the unpleasant feelings aroused by minor chemical odors (multiple chemical sensitivity), also common in ill GW veterans.[1]
- Group A likely to be GWS Syndrome 2

Binns et al., 2004 GWVI-RAC report, Haley, et al., 1997