

Presentation 4 – John Hart, Jr.

## Gulf War Illness Neuroscience Projects Overview

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## Gulf War Illness Symptoms

- Trouble finding words/speech difficulty
- Attention/concentration
- Slow thinking/processing speed/putting things together
- Memory
  - Short-term (frontal lobe)
  - Semantic object (thalamus and basal ganglia)
  - Learning new material (hippocampus)
- Depression/anxiety/hyperarousal/irritability
- Confusion

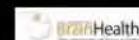
## **GWV Anatomical Regions Affected**

- Basal ganglia
- Thalamus
- Hippocampus
- Amygdala
- Frontal lobes/insula
- White matter
- Brainstem



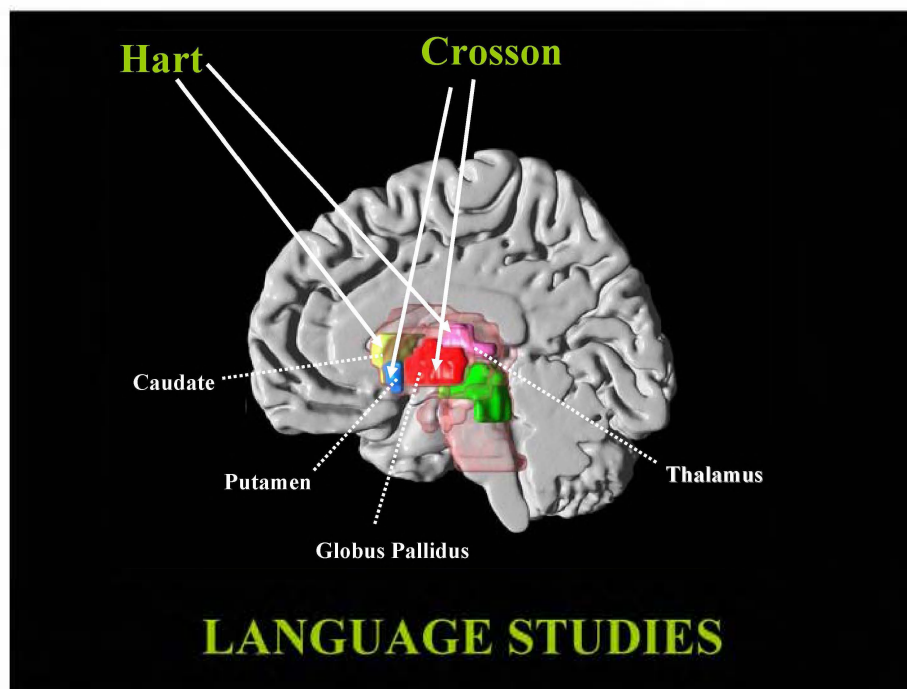
## **Gulf War Neuroscience Projects**

- Word Finding
- Complex Verbal Functions & the Basal Ganglia
- Attention & Executive Function in Prefrontal Circuits
- Auditory Visual Memory Conjunction
- Material Specific Encoding & Recognition in the Medial Temporal Lobes
- Emotional Memory Circuits



## Gulf War Neuroscience Projects

- Word Finding (Hart)
- Complex Verbal Functions & the Basal Ganglia (Crosson)
- Attention & Executive Function in Prefrontal Circuits
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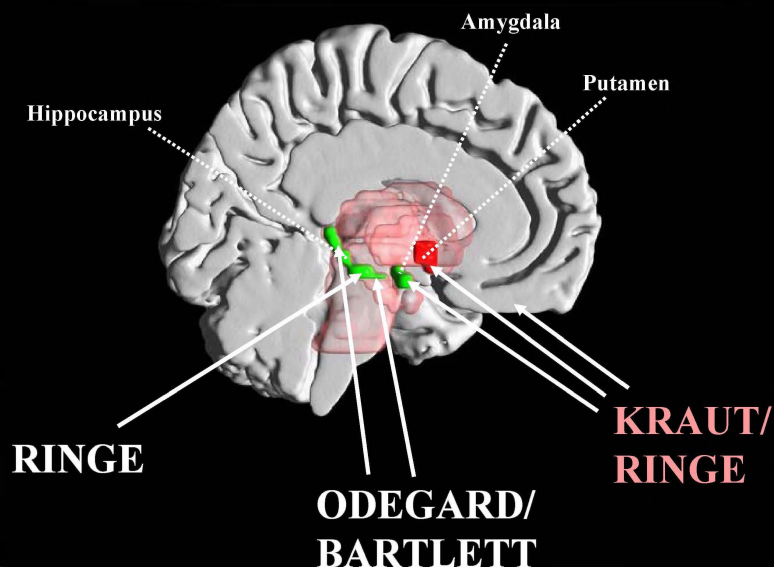


## Gulf War Neuroscience Projects

- Word Finding
- Complex Verbal Functions & the Basal Ganglia
- Attention & Executive Function in Prefrontal Circuits
- Auditory Visual Memory Conjunction (Odegard & Bartlett)
- Material Specific Encoding & Recognition in the Medial Temporal Lobes (Ringe)
- Emotional Memory Circuits (Kraut & Ringe)

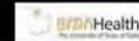


## MEMORY AND AFFECT STUDIES

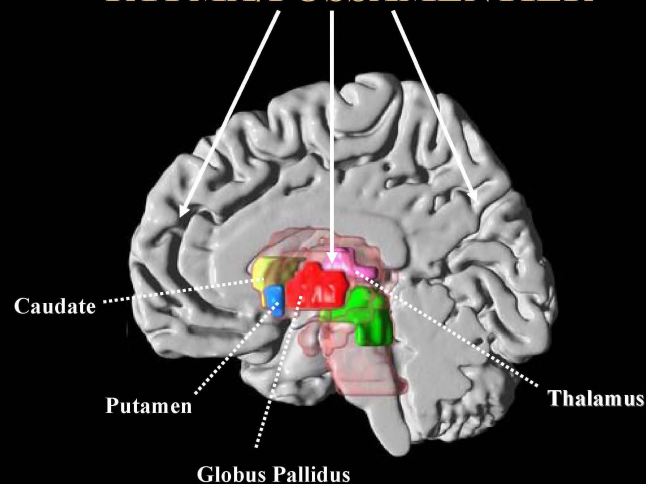


## Gulf War Neuroscience Projects

- Word Finding
- Complex Verbal Functions & the Basal Ganglia
- Attention & Executive Function in Prefrontal Circuits (Rypma & Possamentier)
- Auditory Visual Memory Conjunction
- Material Specific Encoding & Recognition in the Medial Temporal Lobes
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### RYPMA/POSSAMENTIER



### ATTENTION & EXECUTIVE FUNCTION

## Gulf War Neuroscience Projects

- TARGETED INTEGRATION OF RESULTS
  - Hypothesis-driven combined analysis
    - Projects
    - Neuroimaging findings
    - Survey
    - Pre-clinical findings
  - Targets
    - Mechanistic understanding
    - Diagnostic toolset
    - Treatment



## Gulf War Illness Neuropsychological Sub-Core

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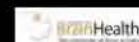
## Neuropsychological Test Battery

- Global cognition
- Attention
- Short-term memory
- New learning (declarative memory)
- Language
- Visuospatial abilities
- Executive functions/reasoning
- Psychomotor speed
- Psychological symptoms
- Motivation/effort



## Neuropsychological Testing

- choice of tests based on
  - symptoms expressed by patients
  - tests previously impaired in studies
  - tests administered to the Seabee cohort when last examined



## Neuropsychological Testing

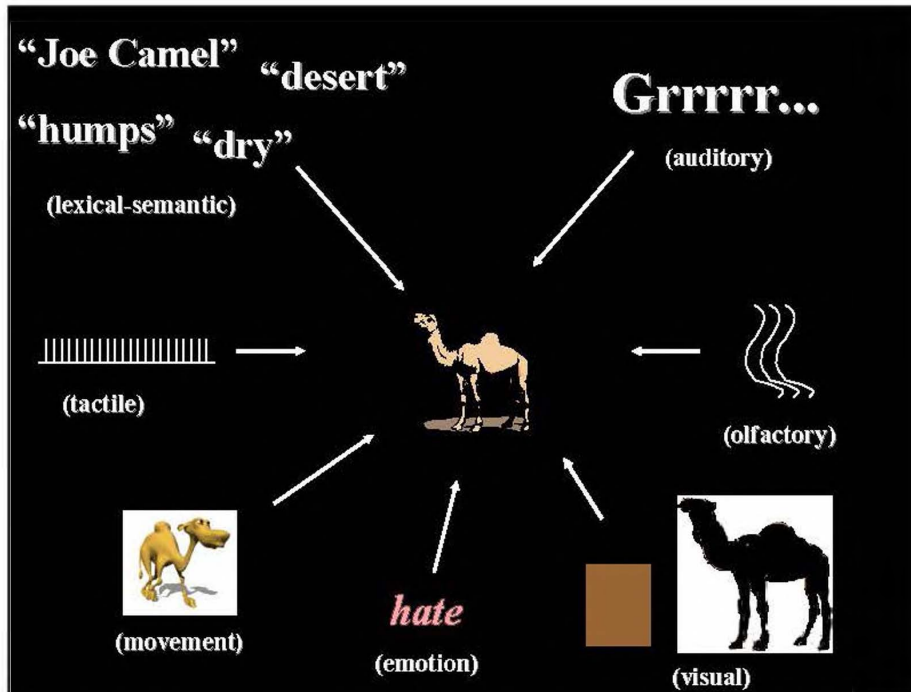
- data will provide first longitudinal assessment of cognitive deficits in GWI
  - deficits with aging
  - recovery
  - static
- provide correlates for other studies
  - symptom checklist
  - illness subtypes
  - neuroimaging



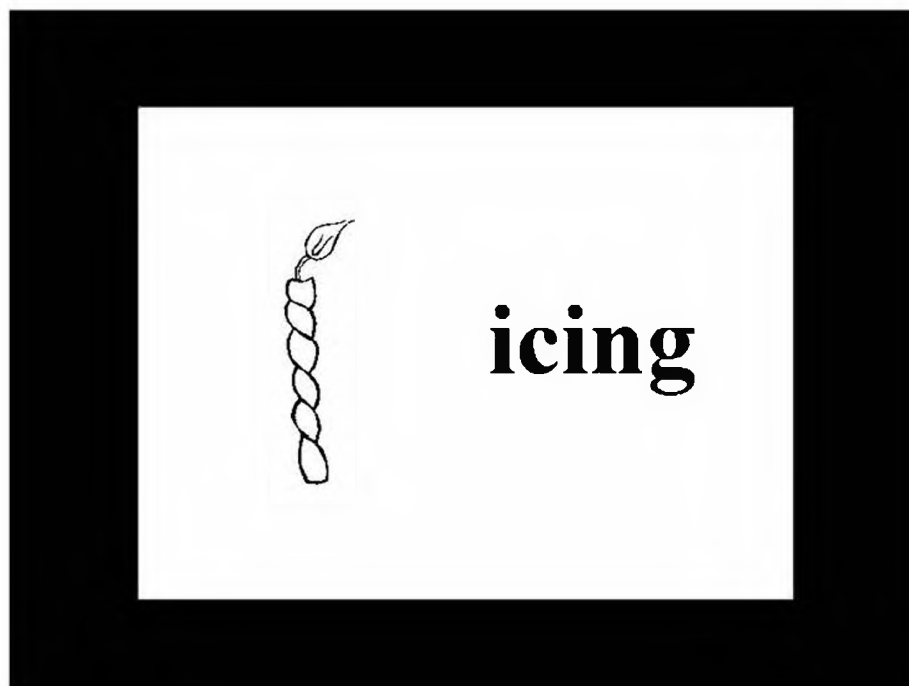
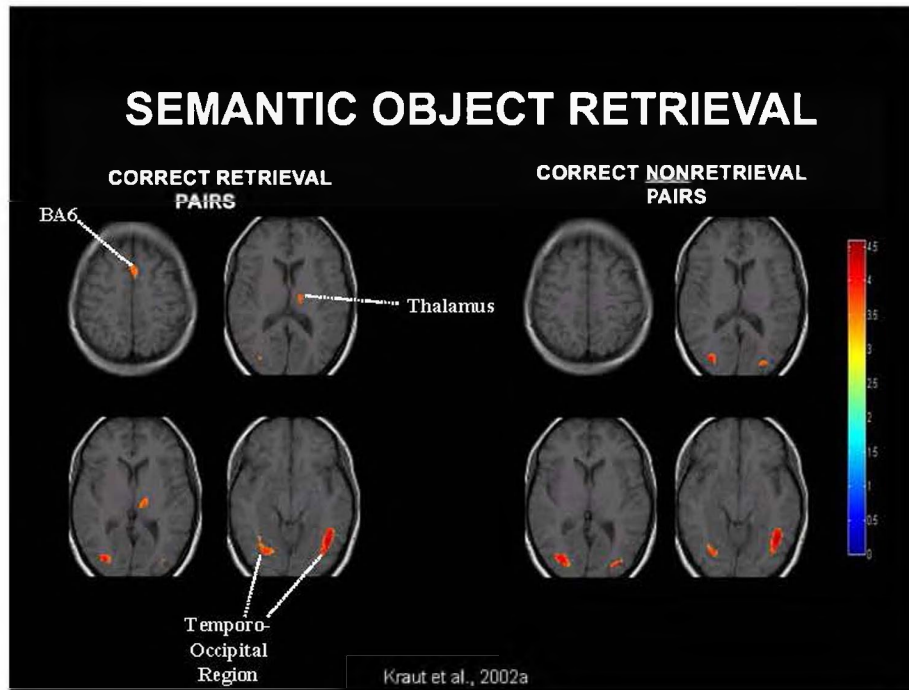
## Gulf War Illness Word Finding Project

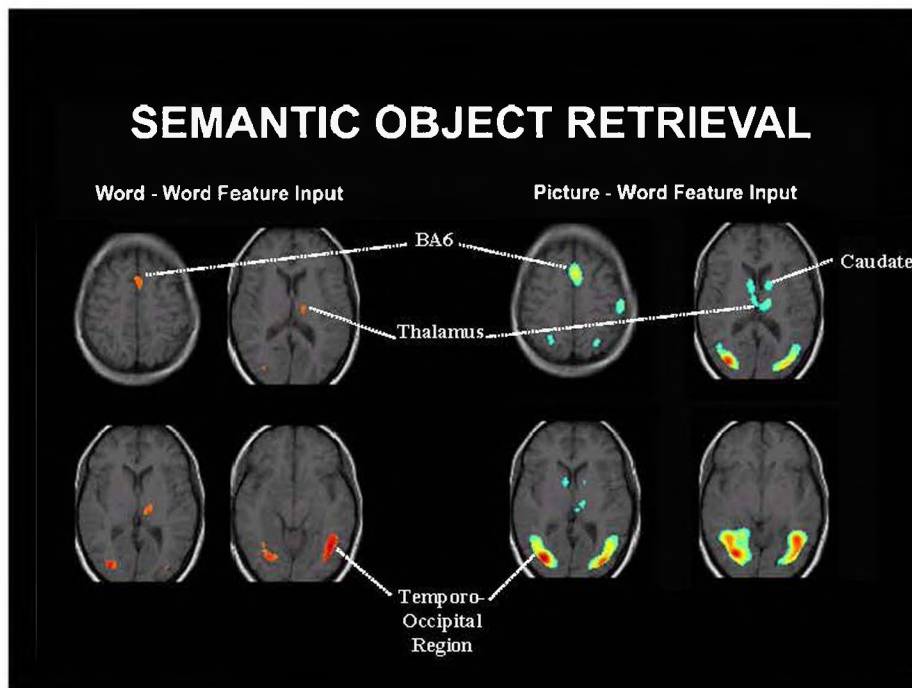
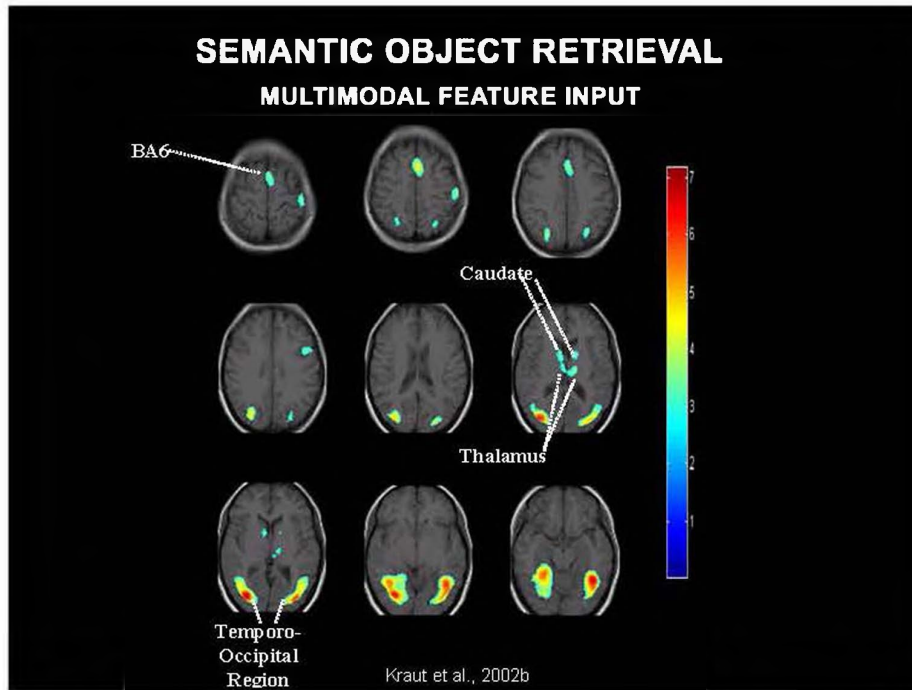
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desert  
humps



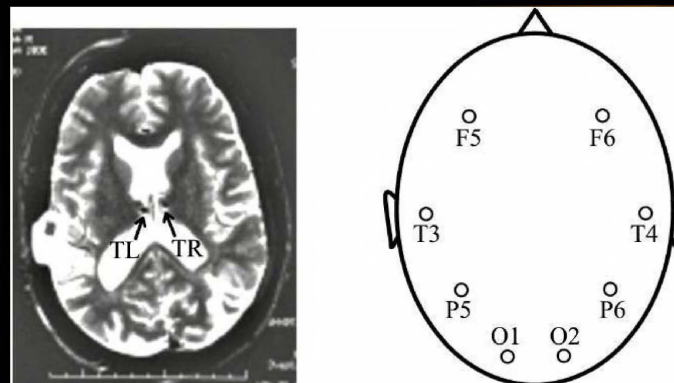


## Expected Regions of Activation during fMRI

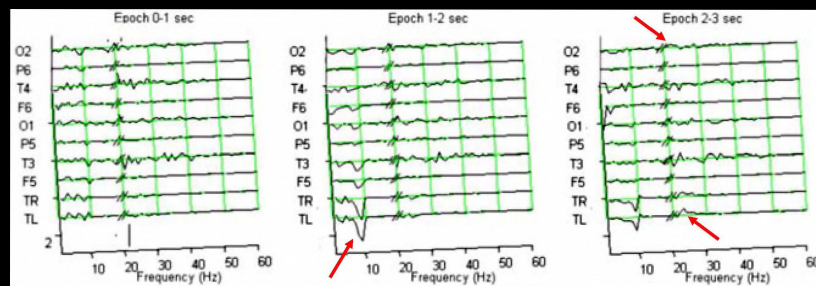
Cognitive Tests	TO	BA 6	Dorsomedial Nucleus	Pulvinar	Basal Ganglia
SORT (picture-word)	B	B	B	B	B
SORT (word-word)	B	B	L	L	
Object-Category Recall (word-word)	B	B			

TO=Temporo-occipital; BA6=Brodmann Area 6; B = bilateral; L = left; R = right

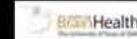
## Thalamic Depth and Scalp Electrode Placement



## Semantic Object Retrieval Test Difference Power Spectra



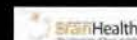
Slotnick et al., 2002



## Semantic Object Memory Retrieval

- EEG alpha power change globally for memory retrieval vs. misses
- EEG gamma power increase in thalamus & occipital for memory retrieval
- synchronized, rhythmical neural firing of regions encoding memory retrieval

Slotnick et al., 2002



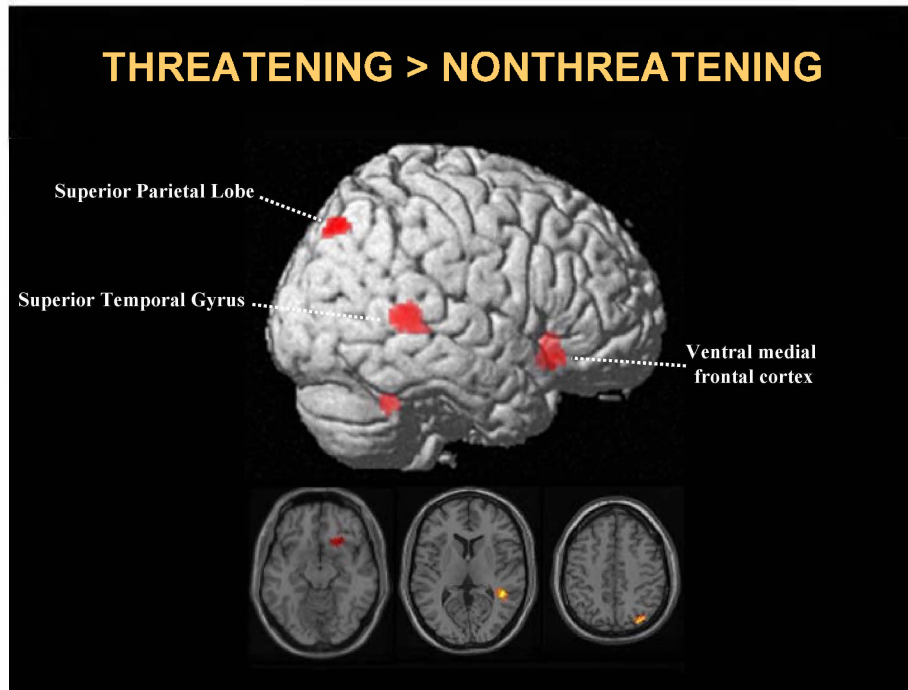
## Analysis of Semantic Object Memory Retrieval in GWI

- fMRI detecting if brain regions are normally activated
- EEG alpha and gamma power assessment
  - how and why process impaired
  - if performance intact but task harder to do
    - EEG power and timing of EEG connectivity can detect



## Gulf War Illness Emotional Memory Circuit Project

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Wendy Ringe  
Assistant Professor of Psychiatry  
UTSW




### Threatening Sound Semantic Memory Circuit

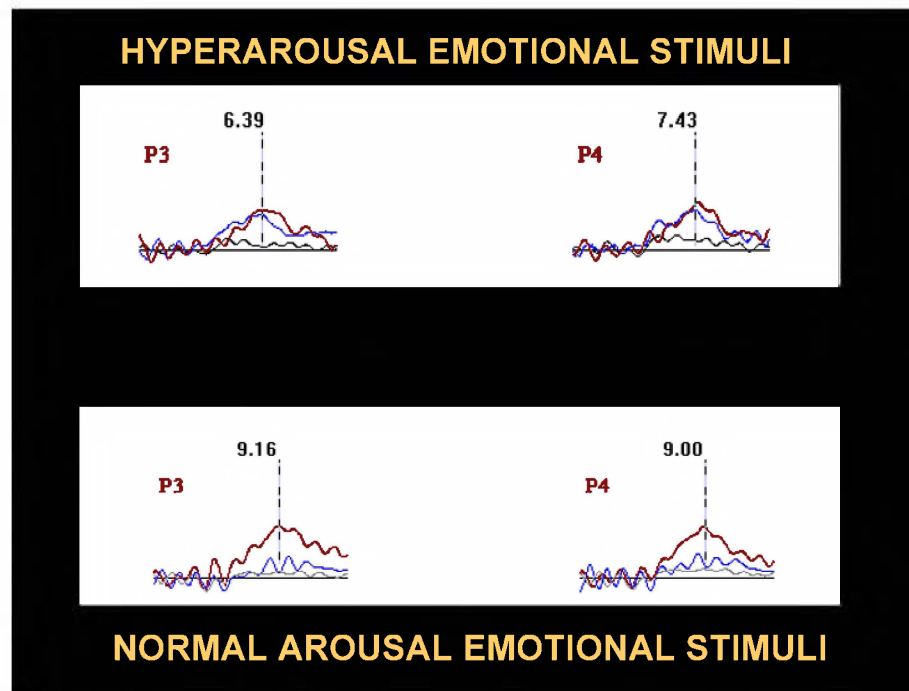
- lateralization to right hemisphere
- right STG → early semantic memory detector
- right medial inferior frontal → links with limbic representations
  - gates access to amygdala

Ventral medial frontal cortex

Amygdala

This image shows a lateral view of a human brain with several colored spots indicating areas of activation. A red spot is labeled 'Ventral medial frontal cortex' and a green spot is labeled 'Amygdala'. There are also blue and orange spots. A horizontal rainbow-colored bar is positioned above the brain image.





## Analysis of Threatening Memory Circuit in GWI

- ERP to see if auditory and/or visual hyperarousal response
- fMRI see if regions encoding visual & auditory threat same in groups
- determine if encoding, gating, or over-responsiveness basis of difficulty
  - relate to cognitive symptoms
  - integrate with targeted neuroimaging markers