

Human Sciences Research: Neurosciences and Cognitive Science Factors



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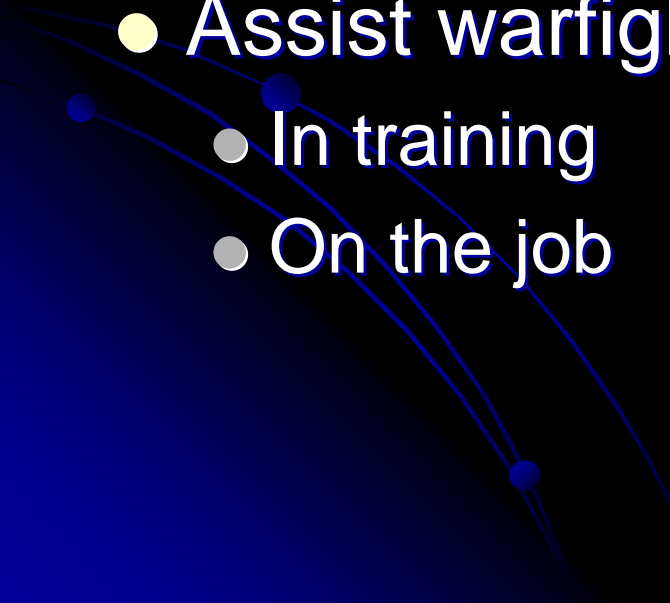
Background: A Confluence of Factors

- Higher OPTEMPO, frequent deployments
- Reduced manning
- Asymmetric/complex warfare
- The “coddled” generation
 - San Diego State U. study on narcissistic tendencies of our youth

What are we seeing?

- Increased use of
 - Alcohol
 - Drugs
 - Tobacco products
- Increases in risky behaviors
- COSRs and PTSD

How can the Neurosciences Help?

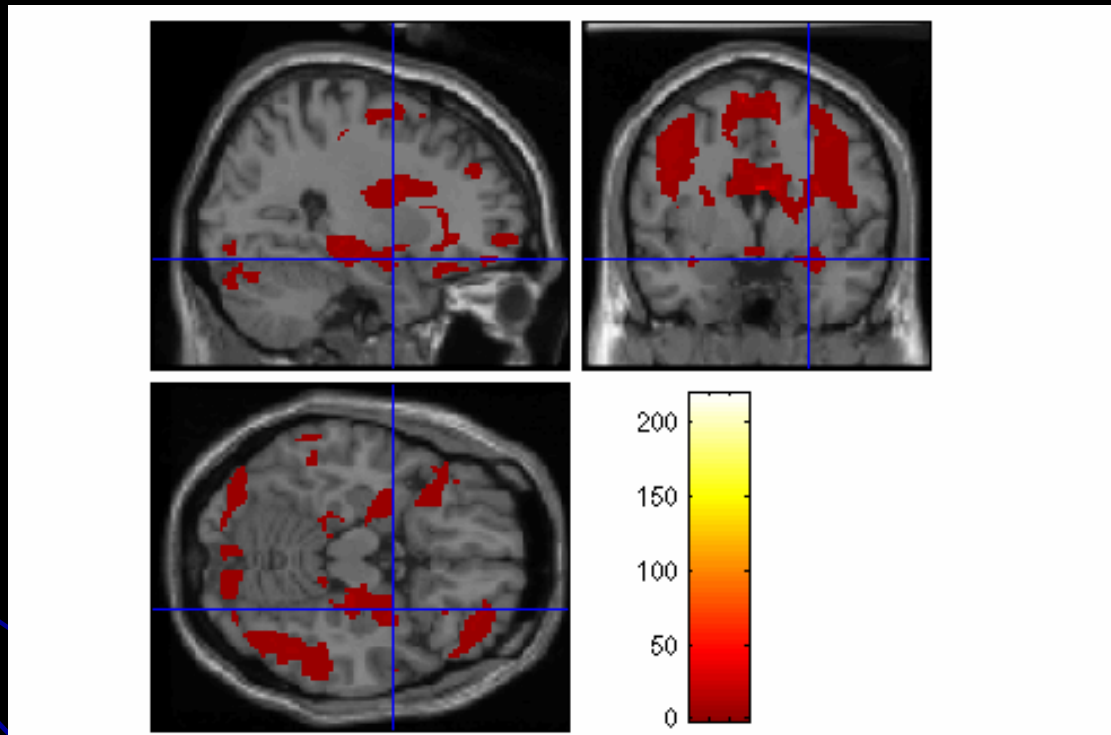
- Identify individuals at risk
 - For adverse stress responses
 - Brain injuries/illnesses
 - Assist warfighters
 - In training
 - On the job
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Stress responses and associated mechanisms

- Amygdala, cingulate, insula, HPA axis
 - Lack of inhibition → poor regulation of stress response, emotions...
 - Anxiety, personality disorders
 - COSRs, PTSD
 - Genetic component, 5"-HT promoter gene (Meyer-Lindberg)
- Locus Coeruleus
 - Tonic/Phasic → distributed/focused attention (Aston-Jones)
- SERE studies at Ft. Bragg and San Diego (Morgan, Taylor)

NHRC SERE Study:

Does brain activity to emotional stimuli correlate with SERE performance measures?

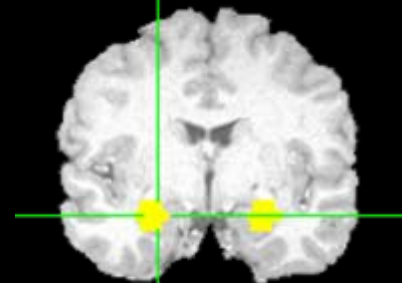
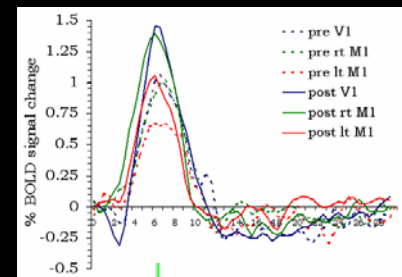
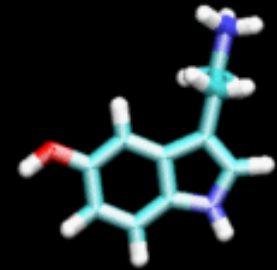


**Noteworthy amygdala reactivity to ANGRY facial stimuli
(group images, $n = 4$, $p < .05$)**

Early results:

What is Pharmaco-fMRI?

- Combine:
 - Human pharmacology
 - Magnetic Resonance Imaging
 - Blood Oxygen Level Dependent (BOLD) Contrast
 - Specific Brain Processes: Behavioral Tasks
 - Target Brain Structures



(Slide courtesy of Martin Paulus, UCSD)

Assisting the Warfighter

- 20+ years of psychophysiology
 - Fatigue, workload
- Recent advances in signal acquisition, signal processing speed and methods
- DARPA's Augmented Cognition program
 - EEG, eye activity, FNIR, HRV
- Closed loop adjustment of automated processes based upon psychophysiological feedback



Cognitive Cockpit (CogPit) Example



- Alion Science & Technology BMH Operation & NAVAIR
 - The Advanced Tactical Aircraft Simulator (ATAS)
 - Closed-loop system mitigates adverse effects of high workload during simulated strike missions

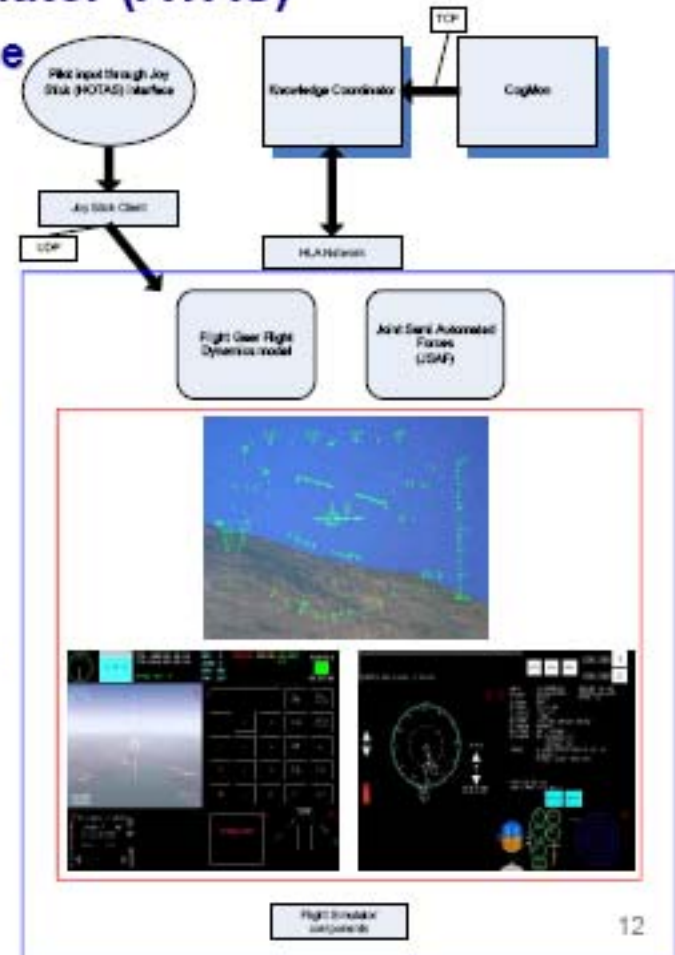


- Knowledge Coordinator (KC)
 - Operator can monitor pilot's cog. load
 - Manipulate load via role playing & direct interaction w/ pilot via the operator station

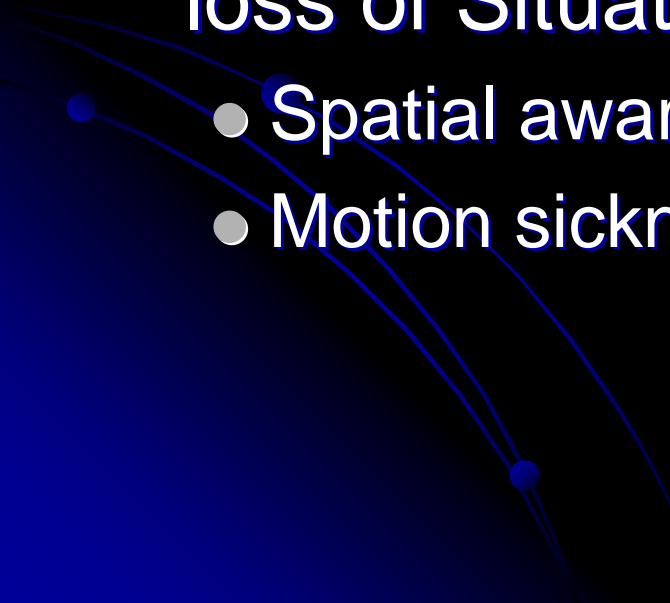
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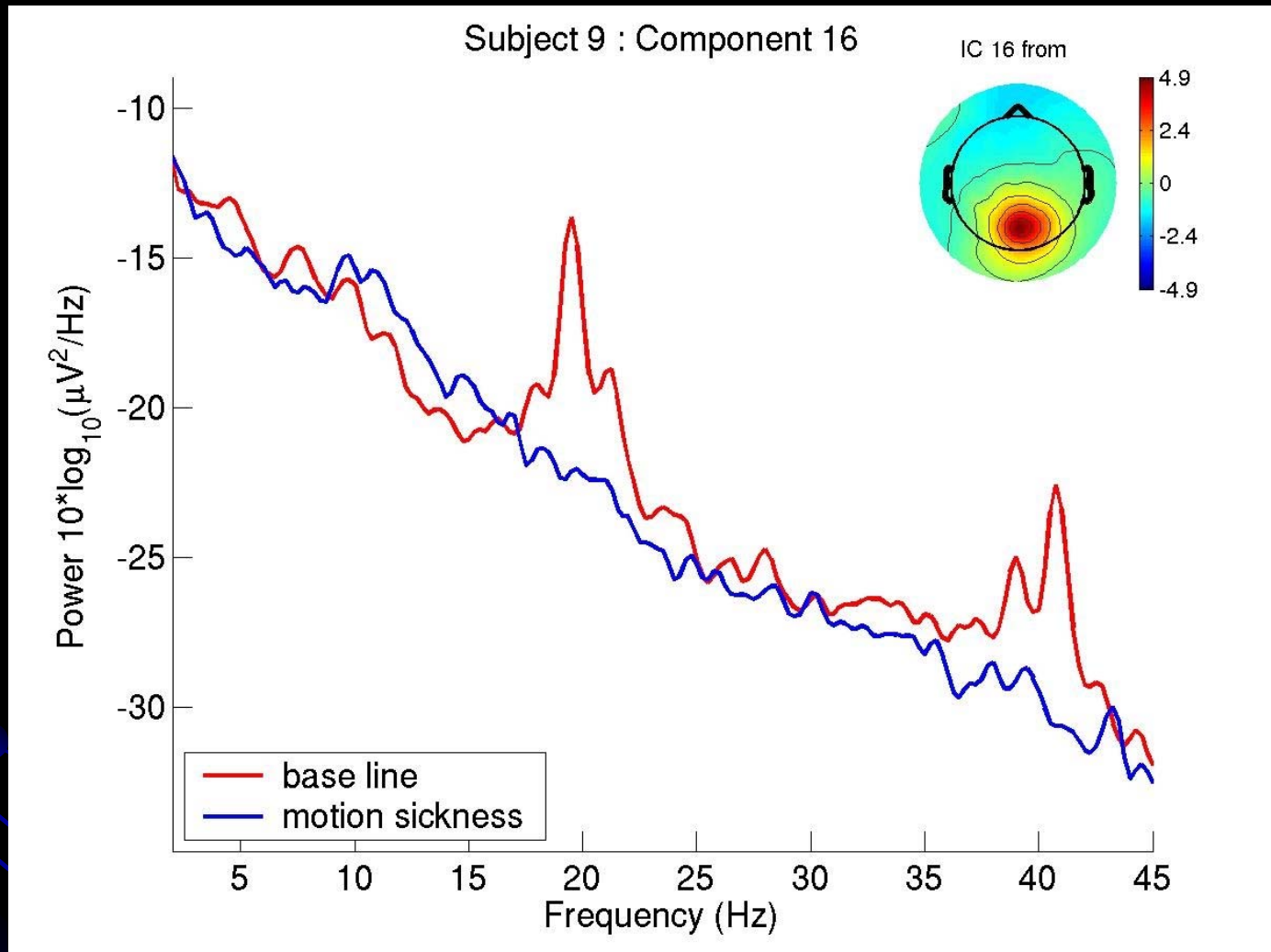
All images and video courtesy of Alion & NAVAIR



Assisting the Warfighter (cont.)

- New possibilities: detecting “doubt” in the brain
 - Schachter’s work on “false” memories
 - Perhaps we can see signs of Confusion, loss of Situational Awareness
 - Spatial awareness
 - Motion sickness
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Spectral Correlates of Motion Sickness Onset



Prominent power peaks at 20 and 40 Hz in ventral midline sources during the tracking (light colored line) that are suppressed during motion sickness (darker line).

(Slide courtesy of Erik Viirre, NHRC)

Summary

- Behavioral Neurosciences and Cognitive Sciences can:
 - Identify and understand important brain systems that mediate stress, anger, fear and other emotional responses
 - Identify and understand systems that are important to operational performance
- With this knowledge, we can work to **protect, enable and enhance** the health and performance of military personnel